Current Science, Vol. XIII, 1944

Author Index

Title Index

CURRENT SCIENCE

Vol. XIII] JANUARY 1944 [No. 1

THE TRAINING OF RESEARCH AND TECHNICAL PERSONNEL

SINCE the commencement of the year 1944, there have been notable utterances from the leading statesmen, industrial magnates, economists and scientific men regarding post-war reconstruction of our agriculture and industry. There is complete and wholehearted unanimity on the question of the utilisation of the immense natural resources of the country with the aid of tools offered by modern science and technology. In 1938, Lord Rutherford, in the course of his address to the Silver Jubilee Session of the Indian Science Congress, held at Calcutta, dealt at considerable length with the question of organisation of scientific research in India. He said, "This is in a sense a scientific age where there is an ever-increasing recognition throughout the world of the importance of science to national development. A number of great nations are now expending large sums in financing scientific and industrial research with a view to using their natural resources to the best advantage." The present war which has since intervened has brought into prominent relief the weaknesses in the agricultural and industrial economy of this country.

In the course of his Presidential Address to the Section of Engineering and Metallurgy Mr. Ghandy drew attention to the position of Indian industry as compared with those of the advanced countries. He said, "We are not able to manufacture aircraft or automobiles. A proper shipbuilding industry is still unknown. Our requirements of heavy machinery have to be supplied from abroad and we are content to utilise the great reservoir of scientific talent that exists in the country for the purpose of maintenance and operation of machines designed and constructed in foreign countries. What heightens the sense of tragedy is the fact that a country so unusually rich in natural resources as India should be so backward in industrial development."

Addressing the delegates of the Indian Science Congress held at Delhi, Prof. A. V. Hill spoke on the fundamental principles which guided the organisation and development of scientific and industrial research in England. In the course of this talk he referred to the four M's which are essential for the progress of science, men, money, material and machinery.

Of these, the last three could be mobilised; an enlightened and sympathetic government can enlist the enthusiastic co-operation of the public in finding the *money* and can arrange for the import of the necessary *machinery* to meet the urgent and immediate requirements of industrialisation. Nature has been exceptionally bountiful to us and can supply the raw *materials* needed for industry. The supply of *men*, however, offers difficulties.

The Government of India have constituted a Post-War Reconstruction Committee which has been entrusted with the task of planning the various nation-building activities during the post-war period. A few days ago, the leading industrialists of the country have published a memorandum outlining a Rs. 10,000 crores plan of economic development for India, which is to be given effect to in three stages.

Professor Sir J. C. Ghosh, in the course of his Presidential Address to the Annual Session of the National Institute of Sciences, has pleaded for the immediate inauguration of a National

Research Council with the following functions: (a) to plan the main lines of scientific work in accordance with national needs, to formulate schemes for the above purpose, to review and modify the same whenever necessary and to recommend ways and means for implementing the results of accomplished researches: (b) to ensure balanced development of all branches of science and minimise overlapping: and (c) to advise and help relevant authorities regarding the training and supply of scientific personnel for pure and applied research.

The speed of scientific and technological progress will be limited by the supply of scientific and technical personnel. The training of highly competent and skilled personnel takes a long period. The selection and rise of the specially gifted among these workers will follow as a matter of course. Adolph von Bayer, the celebrated German chemist, who gave synthetic indigo to the world, once said that it took three years to train an infantry man, five years for a cavalry man, seven years for a gunner and nine years for a chemist. Dr. Bhabha, in a contribution to the symposium on post-war organisation of scientific research in India, writes, "Even if money is found for equipment, a highly trained and gifted staff cannot be created in less than a decade". Professor Sir Bhatnagar is of the opinion that the National Research Council, when founded, should take upon itself the responsibility of not only planning scientific work in accordance with national needs but also help in the training and supply of scientific personnel for pure and applied research. Sir J. C. Ghosh has invited attention to the way in which Russia faced the problem of supply of men. "In the planning of the development of scientific research, the Soviets began with the finding and training of men and then built the Institute later. They did not start with paper plans of Institutes in which men were subsequently made to fit." Emphasis should be laid upon the finding and training of researchers who would be called upon to tackle problems of industrial advance.

Even in England, it has been admitted that the number of trained personnel is inadequate to meet the growing demands of post-war reconstruction. "Admitting that the pre-war provision for research in Great Britain compares favourably with that of the U.S.A. or of Soviet Russia, it must not be supposed that the position can be rectified immediately by the allocation of financial and material resources more commensurate with the effort required. The supply of personnel alone, as Sir Stafford Cripps observed, is an obstacle to rapid expansion."

At the commencement of the first five-year plan which Soviet Russia launched soon after the last Great War, she was faced with a similar problem. It is instructive to recall how the question was tackled by her since India is faced with a closely analogous situation. Mr. Ghandy, in his Presidential Address referred to above, has outlined the scheme adopted by Soviet Russia in mobilising their technical personnel. "The 'peoples' Commissariat of Education as the name signifies is in charge of education. It seems that a proper scientific bias is given to education. 'Pioneer palaces' or children's clubs, with their science laboratories and their exhibitions help the growth of a scientific outlook in the minds of young students, while science courses at the schools and the universities and the facilities for the conduct of research at the university laboratories in collaboration with the Science Research Institute of the Academy of Sciences, complete the scientific training of students and turn out a regular flow of scientific workers for the benefit on the community at large."

On the eve of Russia entering the present conflict "a decree signed by President Kalinin introduced *a* system for the replacement of schools under the control of individual factories and commissariats by the Government controlled schools organised on a national plan. It was not long before a network of industrial technical schools came into existence in Russia, Moscow alone having seventy such schools towards the end of the year 1942, each specialising in a particular branch of industry.

"Offering the attraction of a free education, free uniforms, and three free meals a day and guaranteeing decent employment at the end if a diploma is obtained, these schools have drawn hundreds and thousands of youths, including girls, in their middle teens, and have already provided tens of thousands of qualified workers for war industries." Here is an illustrious example of how the talent of a whole people could be harnessed by a national government for the promotion of its industry.

Two classes of workers are needed for reconstruction, the research worker and the technician. It is generally agreed that the universities should take the responsibility of producing the researcher while trade schools and polytechnic institutes should turn out the technicians. At the moment, the universities in India are not adequately staffed and equipped, to take up the additional responsibility of producing a larger number of scientific workers; admissions to the science and technical courses are restricted due to limited accommodation and poor facilities that exist. The trade schools and polytechnic institutes are few and far between considering the size of the country and the magnitude of the work that lies ahead. Given the necessary funds there should be little difficulty in expanding the teaching and research activities of the universities and increase the flow of trained research personnel. Large sums of money should be expended for the promotion of technical schools and for the establishment of a chain of polytechnic institutes throughout the country. These schools and institutes will provide the technicians needed for the advancement of industries during the post-war period.

We must take stock of our present scientific and technical personnel. A national register enrolling all the personnel available in the country may immediately be opened either by the Department of Education or by the Department of Labour. When the war terminates an appreciable number of scientific workers and technicians will be released and the question of their absorption by science and industry

should be carefully planned. These questions are best considered by a special committee which may be set up by the Central Government. Large capital grants both for university and technical education and research should be allotted; Sir J. C. Ghosh has suggested that a sum of Rs. 2·5 crores per annum should be expended for this purpose. The conditions of service should be rendered sufficiently attractive to induce the best of our young men to adopt a career of research or technology. The Government should consider the inauguration of a State Scientific Service on a parallel with the administrative Civil Service. It is earnestly to be hoped that the Government of India will give its immediate attention to this fundamental question of organising a steady supply of scientific and technical personnel for post-war reconstruction.

BEQUEST OF PAVLOV TO THE ACADEMIC YOUTH OF HIS COUNTRY

WHAT can I wish to the youth of my country who devote themselves to science?

Firstly, gradualness. About this most important condition of fruitful scientific work I never can speak without emotion. Gradualness, gradualness and gradualness. From the very beginning of your work, school yourself to severe gradualness in the accumulation of knowledge.

Learn the ABC of science before you try to ascend to its summit. Never begin the subsequent without mastering the preceding. Never attempt to screen an insufficiency of knowledge even by the most audacious surmise and hypothesis. Howsoever this soap-bubble will rejoice your eyes by its play it inevitably will burst and you will have nothing except shame.

School yourselves to demureness and patience. Learn to inure yourselves to drudgery in science. Learn, compare, collect the facts!

Perfect as is the wing of a bird, it never could raise the bird up without resting on air. Facts are the air of a scientist. Without them you never can fly. Without them your "theories" are vain efforts.

But learning, experimenting, observing, try not to stay on the surface of the facts. Do not become the archivists of facts. Try to penetrate to the secret of their occurrence, persistently search for the laws which govern them.

Secondly, modesty. Never think that you already know all. However highly you are appraised always have the courage to say of yourself—I am ignorant.

Do not allow haughtiness to take you in possession. Due to that you will be obstinate where it is necessary to agree, you will refuse useful advice and friendly help, you will lose the standard of objectiveness.

Thirdly, passion. Remember that science demands from a man all his life. If you had two lives that would be not enough for you. Be passionate in your work and your searchings.

H. E. LORD WAVELL ON INDIAN SCIENCE

INAUGURATING the Thirty-first Session of the Indian Science Congress, His Excellency Lord Wavell said:—

"India, one of the oldest civilisations, has perhaps felt the impact of modern science later and less than any other great people. A large proportion of her population still lives the old life untouched by the vast changes of the century. Her realm has been of the spirit rather than of the earth. It may be said of the West hereafter that we took too much from India materially and too little spiritually.

But if India is to play the part in the world to which her size, her population, her history and her position entitle her, she too must make every possible use of scientific advancement.

She has already produced many great scientists, she bears many more in her fertile womb. Her contributions to science have always been on the side of peace and progress. She has everything to gain by combining modern science with her old culture indeed her traditional outlook should enable her to make an increasingly fine and characteristic contribution to natural knowledge. Indian science has made in fact a very remarkable stride forward during the last twenty-five years, as is shown by the foundation of many new societies, new journals and new departments of science in universities and under Government.

In this war science has played a great role in India as elsewhere. It has made a splendid contribution to maintaining the health of the fighting men, through the activities of such bodies as the Malaria Institute, the Indian Research Fund Association, the Nutrition Laboratories at Coonoor, and others. It has also played an important part in munitions production and in solving problems of supply. As an ex-Commander-in-Chief, I should like to thank Indian science for the invaluable assistance it has given to the armies in the field.

It must play a great part also in post-war development. The coming years will be vital to India. She must learn to make use of her abundant resources with the aid of science. Science is the most international of all human interests.

Professor Hill has himself said in an address elsewhere: 'I believe that the pursuit of knowledge for the welfare of mankind is one of the greatest agents for goodwill between men in every land.' It is in that belief that he is here to-day.

This Session of the Indian Science Congress has a momentous task to perform; to discover how best to bring the aid of science to the development of India's great resources in agriculture and industry, to the improvement of health and to social advancement and prosperity."

COCONUT SHELLS AS AN INDUSTRIAL RAW MATERIAL

II. MISCELLANEOUS USES: FUEL

By Dr. REGINALD CHILD

(*Director, Coconut Research Scheme, Ceylon*)

THE first article[17] of this series reviewed in some detail the present state of knowledge of the chemical composition of coconut shells. This, the second, article aims at describing uses which have been made of shells in the past and are being made at the present time.

Utilization of Shells as Such

The uses which will be dealt with under this head can scarcely be described as industrial, but rather as domestic and ornamental.

Coconut shells have always been used in the domestic economy of coconut-growing countries in a variety of ways. To go no further back than the seventeenth century, Robert Knox[18] relates how that "..... when they (*i.e.*, the Sinhalese) meane to make a bottle of the nutt they make but a little hole in one end & keepe it tell all the meate in the inside is rotted out & then it is like a bottle without a necke, in which they keep Racke* or oyle or any other liquor: some will hold a quart. The cups or dishes is onely to split the nut in the Middle as it will doe easear than any other way & then thare is 2 Cups made of one nutt."

Old Knox overlooked the fact that the half carrying the eyes is apt to "spring a leake" when the soft eye decays and that after all only one practicable cup is obtained from one "nutt". However, half-shells continue to be used in Ceylon as drinking cups in toddy taverns, as receptacles for collecting rubber latex, fitted with handles as scoops and ladles, and as begging bowls.

Bennett (1843)[19] gives a similar account and mentions containers for oil lamps and "sportmen's liquor flasks"! He also refers to the employment in Ceylon of a coconut shell as a resonant backing for a musical instrument. "The Singhalese *Vinah* is formed of a neatly carved or polished coconut shell (of which about a third part is cut off) and covered with guana skin (*Lacerta iguana* L.); to this is fixed a solid handle of about an inch in diameter, which is generally lackered with various colors, and, on the opposite side of the shell, a sort of peg is fixed, to which two strings, one of horse-hair, and the other of fine bow-string hemp (*Sensivierra zeylanica*), are attached; these strings are passed over a wooden bridge, upon the centre of the covering, one horizontally, and the other upon an inclined plane, the slope commencing from within three inches of the extremity of the handle, where it is perforated large enough to receive a strong peg of nearly half its circumference, and of about a fourth part of its length, having at the point a notch for the reception of the strings, which, by turning the peg, are kept in a state of tension, like the strings of a violin.—This instrument is played upon with a bow. ....."

Watt (1889),[30] says that "by Hindus, the dried shell is almost universally used as the water-bowl of their smoking-pipes or *hukah*. In Madras these shells are made into elegantly carved ornamental vases, lamps, spoons, sugar-pots, tea-pots, etc." He also gives a list of 83 different articles prepared from the coconut palm exhibited at the Colonial and Indian Exhibition in the 1880's, which includes several shell articles.

Burkill (1935),[20] has some interesting particulars of coconut shell vessels used in Malaysia. "The measure of capacity known as a 'chalok' is what a coconut scoop will hold. A 'chupak' is the amount which half a coconut shell will hold." Similarly Grisard and Vanden-Berghe (1889),[21] note that in Siam "..... les noix de *coco coupées en deux sont graduées et employées comme mesures de capasité dans le trafic des graines et des liquides.*" Burkill adds some curious information on Malaysian folk-lore: "..... in Java, ... the coconut shell is held to be the appropriate vessel for medicines. In Sarawak, medicinal preparations in connection with births must be given in a coconut shell. Among the Malays a coconut shell vessel is used in a rice-ceremony because evil spirits must be confronted with objects which they recognize (Skeat, *J. Roy. Asiatic Soc.*, Straits Branch, 1898, 31, 13). In the Nicobar Islands a baby until two months old must only be washed in water from the shell of a young coconut (Whitehead, *In the Nicobar Islands*, 1924, p. 121).

The manufacture of such articles as have been mentioned has of course been often more than merely utilitarian, as the reference above to Watt's *Dictionary* indicates. Coconut shell is hard, takes a high polish, can be carved, if with some difficulty, decorated with lacquer, inlaid with silver or other metals, and generally used with ornamental effect. Local craftsmanship has, therefore, produced articles of frequently very attractive appearance, and characteristic of the native art of the various countries of origin.

Several early writers, including Regnaud (1856)[22] and Grisard and Vanden-Berghe[21] have noted that by washing with an alkaline solution and/or rubbing up with oil, coconut shell takes on a fine dark-brown to black shade, which enhances the attractiveness of articles made therefrom. "Gratée et polie", says Regnaud, "puis frottée d'huile ou lavée dans une solution alcaline, la noix de coco devient d'un beau noir, et se transforme, entre les mains d'un ouvrier industrieux, en toutes sortes d'ustensiles de ménage ou de simple fantaisie."

Of decorative work illustrations have been published of very ornate Indian work (lamps, goblets, flower-vases, etc.) by J. Shortt (1888),[23] of combs, ladles, bowls and stands, and water-dippers from East Africa by Hamel

* *i.e.*, arrack.

Smith and Pape (1914),[24] and of more modern Ceylon ware by Pieris (1936).[25] Three good illustrations in Pieris' little volume show bangles, buttons, cuff-links, ash-trays, trinket-dishes and paper-weights; and a complete tea-set, including pot, six cups and sugar-bowl. Some of these are perhaps to be described as articles "de simple fantaisie"; the tea-set for example, is probably more ornamental than useful. Buttons and similar things such as studs are, however, practicable; Little (1908)[26] had many years before noted the occasional manufacture of buttons in Malaya, and even said, "it is proposed to send the shell to Europe for button manufacture".

It would doubtless be possible by curious literary research to extend considerably the foregoing account of domestic and ornamental uses of coconut shells; but the main features have been covered and one further reference must suffice. O. F. Cook (1910),[27] in the course of his attempt to show by botanical and historical evidence that the coconut palm had its origin in South America (a conclusion not now usually accepted), has a good plate of a small carved coconut found in a grave in the Chiriqui district of Panama. This specimen is carved in a simple design and is very attractive.

Use of Coconut Shells as Fuel

Of the enormous quantities of shells produced annually in coconut-producing countries (estimates of which are given in a later section), the uses discussed in the previous section account of course for a negligible fraction. Undoubtedly the bulk of shells produced have been and are in most countries used as fuel; they do provide for many purposes an excellent fuel, although Regnaud's comment: "Il n'y a pas au monde un combustible supérieur a la coque du coco" may be taken as rhetorical rather than factual.

Especially in countries where a well-developed plantation industry exists, shells are largely used for firing copra-drying kilns. Burkill (*loc. cit.*), for example, says that "it is the destiny of 70 per cent. of the coconut shells in Malaya to be burned for drying copra".

In Ceylon on most estates copra is dried by direct heat from burning shells in kilns of simple but effective design. Good descriptions of the procedure are given by Cooke (1932),[28] and by Pieris (1940).[29] Cooke notes that in Ceylon nuts are usually allowed to wither in storage for about a month before curing. In consequence a cleaner separation of the husks results and the shells are obtained free from adhering pith and fibre. The shells are also frequently dried before use. In this way clean-burning almost smoke-free fires are given by these shells.

The percentage of total shells used in copra drying naturally varies with conditions and with the efficiency of the kiln and its operators. Cooke (*loc. cit.*, p. 49) states that under unfavourable conditions, as with a draughty kiln or in wet weather, shell consumption may be between 75 and 100 per cent., whilst under good conditions only 25-50 per cent. may be used. In the writer's experience, Ceylon kilns do not attain the latter order of efficiency and about 60 per cent. consumption is probably normal. Lower consumption than this is only obtained in very dry districts where the copra is partly sun-dried (*cf.* Pieris, *loc. cit.*).

On small-holdings, as in S. India and to a large extent in Ceylon, shells are for the most part used as domestic fuel. On estates, any surplus left over from copra curing may also be so used, but in Ceylon, for example, there is a not inconsiderable sale to laundries, bakeries,* lime kilns, brick-yards and others requiring fuel. Cooke notices such uses and states that at the time of his enquiries (1931) the price obtainable was between Re. 0·90 and Re. 1·50 per 1,000 shells, though as much as Rs. 4·00 was paid for larger well-shaped shells for rubber tapping (see previous section).

In subsequent years Ceylon developed a considerable export business in coconut shell charcoal and the price of shells became largely dependent on the export price of charcoal, frequently being as high as Rs. 5·00 per 1,000. (Shell charcoal forms the subject of the next article in this series.) At the time of writing the price of shells at estates is round Rs. 2·00 per 1,000 whole shells.

Working with average Ceylon coconuts roughly 6,000 to 7,000 whole shells go to a ton. (Actual data are given in the next article.) Thus at the 1931 prices quoted by Cooke the fuel cost per ton was between Rs. 5·40 and Rs. 10·50, and compared favourably with other fuel when long transport was not involved. Scientific data do not appear to have been recorded on the calorific value of shells; it is likely to be over 7,500 British Thermal Units per lb.

Shells are not favoured as a boiler fuel; there seems to be a rapid corrosive effect of the vapours on fire-bars, etc., due partly to the high temperature reached and to the acid nature of the combustion products when air-intake is insufficient. (See Article IV on Products of Dry Distillation.) There is also in Ceylon a slight prejudice against their use in the cooking of food, especially meat, which the "creosotic vapours" are alleged to render tough and indigestible.

Shell Ash

The chemical composition of shell ash has been dealt with in the previous article.[17] It seems, however, desirable to conclude the present section on the use of shells as fuel, with a few supplementary remarks on the ash. Burkill is clearly wrong in stating (*loc. cit.*, p. 160) that the ash has but little manurial value, in view of its high potash content. The point is that something like a million shells are required to give a ton of ash. Furthermore, there is some loss of potash by volatization if the temperature of combustion is very high. Georgi (1941)[5] discusses the manurial value of shell ash.

Burkill quotes some uses of shell ash in Malayan native medicine, with which this article may be closed: "The ashes of a coconut shell with pepper, garlic and vinegar, make

---

* At the time of writing (Nov. 1943), for example, one large bakery in Colombo uses some 15,000 shells (about 2 tons) a week.

a medicament drunk after confinement (Skeat, *Mal. Magic,* 1900, p. 346). The ashes, with vinegar only, may be rubbed on the body (Ridley, in *Journ. Straits Med. Assoc.,* 1897, 5, p. 138). In the *Medical Book of Malayan Medicine* (*Gardens Bull.,* S.S., 1930, 6), the ash of coconut shell is prescribed in applications for swellings, pain in the stomach, and rheumatism; it enters also into a gargle. In no case is its presence anything but empirical, and in the treatment of swellings, the use of the eye-end of the shell suggests magic."

It is indeed difficult to see what effect the acetates formed by dissolving the ash in vinegar can have other than as a mild diuretic due to salt action.

17. Child, R., "Coconut Shells as an Industrial Raw Material. I. Composition of Shells", *Current Science,* 1943, **12,** 292–94. See this article for references 1–16, which have occasionally been re-quoted in the subsequent articles. 18. Robert Knox, *An Historical Relation of Ceylon,* etc. (Quoted from the edition published in 1911 by MacLehose & Sons, Glasgow, p. 420). 19. Bennett, J. W., *Ceylon and Its Capabilities* (London), 1843, pp. 87 & 103. 20. Burkill, I. H., *A Dictionary of the Economic Products of the Malay Peninsula* (Crown Agents for the Colonies, London, 1935), Part I, p. 609. 21. Grisard, J., and Vanden-Berghe, M., *Les Palmiers Utiles* (Paris, 1889), p. 68. 22. Charles Regnaud, *Histoire Naturelle, Hygienique et Économique du Cocotier* (*Cocos nucifera,* Linn.), Paris, 1856, p. 125. This little-known work was presented by its author, a native of Mauritius, to the Faculty of Medicine of Paris as his Thesis for a Doctorate. It is an interesting little volume, full of curious information, which deserves to be better known. 23. Shortt, J., *A Monograph on the Coconut Palm or Cocos nucifera,* 1885, Madras Govt, Press, 1888, Plates Nos. 5 & 6. 24. Hamel Smith, H., and Pape, F. A. G., *Coconuts: The Consols of the East,* "Tropical Life," Publishing Dept., London, 1914 (2nd edition), p. 350. 25. Pieris, W. V. D., *On the Uses of the Coconut Palm, with an Illustrated Guide to Coconuts* (Coconut Resesrch Scheme, Ceylon, 1936), p. 7 and Plates 37–40. 26. Little, R., "A Further Use for the Coconut," *Agric. Bull. Straits and F.M.S.,* 1908, **7,** 258. 27. Cook, O. F., "History of the Coconut Palm in America," *Contribution from the U.S. National Herbarium,* 1910, **14,** Part 2, p. 288, Plate 53, Fig. 1. 28. Cooke, F. C., "Investigations on Coconuts and Coconut Products," *Bull. No. 8 (General Science), Dept. of Agric., S.S. & F.M.S.,* 1932, pp. 22–33. 29. Pieris, W. V. D., *Methods of Copra Curing,* Illustrated leaflet, p. 8, issued by the Ceylon Coconut Board, Colombo, 1940. 30. Watt, G., *Dictionary of the Economic Products of India* (Govt. Press, Calcutta, 1889), **2,** 455, *et seq.*

RECENT WORK ON WOOD PRESERVATION AND IMPROVEMENT AT THE FOREST RESEARCH INSTITUTE, DEHRA DUN*

THE importance of protecting wood against destruction by fungi, termites, borers, marine organisms and fire needs no emphasis. The losses due to these agencies are enormous and the importance of wood preservation is obvious. In advanced countries wood preservation is synonymous with timber utilization and its economic importance is recognised. Further, but for the indirect influence of wood preservation on forest conservation, several million acres of forests would not be standing to-day in various parts of the world.

A proper understanding and practice of wood preservation demands a knowledge of several branches of science, *viz.,* chemical engineering, applied physics, chemistry, timber technology and a knowledge of wood destroying fungi, borers, termites and marine organisms, etc.

The foundations of wood preservation research in this country were laid by Sir Ralph Pearson of the Indian Forest Service about thirty years ago. With very limited equipment at his disposal, he carried out experiments on the treatment of railway sleepers and on various types of preservatives.[1] As a result of this work the first commercial treating plant was started by the N.W. Railway. This good work was continued by later officers and among work carried out by them may be mentioned the examination of the treatment characteristics of various species of Indian timbers,[2] natural durability tests, accelerated service tests,[3] service tests on treated sleepers,[4] the development of a new specification for the treatment of coniferous sleepers,[5] which enabled the Forest Department to obtain 50 per cent. more sleepers from the same volume of timber as were obtained before, and the evolution of the preservative Ascu[6] which aroused considerable interest.

The Forest Research Institute is equipped with four pressure cylinders wherein timber, varying in length from 3 to 40 feet, can be treated by all the standard pressure processes, five open tank plants, and a laboratory where all chemical, physical and chemical engineering work connected with the experiments can be carried out.

Toxicity Tests

In co-operation with the Mycologist, experiments are in progress to find out the most suitable fungi for use in toxicity tests. The reaction of Indian fungi to the more important preservative chemicals is being investigated. Toxicity tests on a commercial sample of cashew shell oil showed that, contrary to popular belief, the oil is not sufficiently toxic to wood-destroying fungi.[7] The toxicity of various types of Indian creosotes[8] and ascu[9] to wood-destroying fungi has been studied. Tests on the natural durability of various timbers and accelerated service tests on several preservatives have been carried out in the Institute's test yards.[10]

Preservatives

An important and extended investigation, recently undertaken, deals with the most suitable quality of creosote for use in this country. Several types of creosotes, and creosote fractions, have been and are being subjected to

* Contributed at the request of the Editor, *Current Science.*

extensive studies to evaluate the toxicity, permanence and penetrating power; normal and accelerated service tests are also being carried out.[11] The variation in the quality and quantity of creosote on exposure to atmosphere of treated timber, as also when subjected to oxidation have been investigated with interesting results.[12]

Post mortem examination of several failed ascu-treated poles[13] and treated sleepers from railway lines[14] in different parts of the country after various periods of service, have been carried out with the object of ascertaining the quantity and quality of the preservative still left in them. Some special leaching tests were carried out on ascu-treated timber.[15]

In view of the extreme shortage of preservatives of any kind in the country and the urgent demand for indigenous substitutes for war purposes, oil-soluble preservatives from the copper and zinc derivatives of chir pine resin and cracked vegetable oils have been evolved and tests on them initiated.[16]

Treating Processes and Plant Design

The work on the optimum treating conditions for the more important Indian timbers has been continued. Experiments on the treatment of several species of timbers in pole form indicated that the open tank process gives more uniform penetration than the Lowry process with some species. The difficulties experienced in Assam and on the West Coast in the seasoning of sleepers without decay, prompted an investigation on the conditioning and treatment of several species of sleepers in the green condition.[17] As a result of this work, a steaming and vacuum *cum* Boulton process of conditioning green sleepers has been developed with satisfactory results.[17a]

The treatment of green bamboo army tent poles by various processes has been studied.[18] To meet the demands of the army and other departments several simple designs of open tank plants with simple methods of heating have been developed.[19]

Resistance of Wood to Charcoal

Work on the resistance of wood to corrosion[20] has been continued. Various types of linings for plywood containers have been tested and suitable coatings evolved for a variety of purposes including the storage of petrol.[21]

Resistance to Fire

Among other lines of investigation receiving special attention, may be mentioned studies on the resistance to fire of Indian timbers, both in the natural and treated states. The natural resistance to fire of 52 species of Indian timbers has been investigated.[22] Suitable apparatus was evolved for this purpose and the laws governing the burning of wood elucidated.

A fire-retardant composition, utilizing mica waste, has been evolved and the effectiveness of various compositions studied.[23] The influence of the cross-section of the member on the efficiency of fire-retardant treatments has also been studied.[23]

Thermal Properties

The thermal conductivity of over sixty species of Indian timbers in the air-dry condition has been examined.[24] Recently the specific heat of wood has also been investigated.[25] Preliminary experiments indicate that contrary to other work, probably some variation exists between species with regard to this property.

Electrical Resistance

In continuation of earlier work,[26] work on sleepers, poles and plywood has been taken up.

Permeability

In view of the importance of the knowledge of the factors affecting the permeability of wood with regard to wood preservation, etc., studies on the permeability of wood and other materials have been undertaken with interesting results.[27] This necessitated the design of a suitable clamp to avoid the necessity of end-sealing specimens, and other apparatus.

Sound Absorption

The sound absorption coefficients of various types of fibre and bark boards made at the Forest Research Institute and vibrating systems have been investigated.[28]

Improved Wood

Investigations on the production of "improved wood" by impregnation with synthetic resins have been carried out with interesting results.[29] Experiments on compressed wood also yielded interesting data.[29] Both laminated[30] and compregnated[31] wood have been produced from various Indian timbers and their properties studied. The influence of species, veneer thickness, adhesive used, the direction of laying of the veneers, and the conditions of pressing on the properties of the resulting product have been investigated. Compregnated wood, even from such an inferior timber as *semul*, has been found to compare favourably with foreign samples. Various parties are interested in the use of the material for ships tail shaft bearings, gear wheels, air-screw blades, shuttles. etc.

Adhesives

A scheme of research on various forms of plywood adhesives was initiated in April 1941. A systematic investigation of caseins of Indian origin was undertaken, and various formulae for casein glues tested.[32] In view of the acute shortage of casein, other sources of proteins from indigenous materials for adhesives have been explored with encouraging results. Suitable adhesives have been developed from the proteins of oil seed cakes, seed proteins, etc.[33] Highly water-resistant adhesives have also been developed from the aq. alcoholic extracts of cereal meals.[34] Urea-formaldehyde resins, stable in syrup form for a few months and comparing favourably with foreign adhesives, were developed in response to requests from various departments.[35] Tar acid-formaldehyde resin adhesives were also developed from Indian tar acids with good results.[36]

Cork-Substitutes, Boards, etc.

In view of the acute shortage of cork, bottle stoppers were made from softened *Cryptomeria japonica*, which have been found suitable.[37] Various types of composition corks have also been developed from tree barks. Composition boards have also been made from sawdust and wood shavings using various types of binders.[18]

D. N.

---

1. Pearson, R. S., *Indian Forest Record*, **3**, Part **2**; **6**, Part 4. **2.** Warr, J. H., and Kamesam, S., *Ibid.*, **9**, Part 10; Popham, F. W. J., *Indian Forest Bulletin*,

75. 3. Kamesam, S., *Ibid.*, 64. 4. Pearson, R. S., *Ibid.*, 53; Warr, J. H., *Ibid.*, 59; and Kamesam, S., *Ibid.*, 85. 5. Kamesam, S., *Ry. Bd. Tech. Pap.*, 271. 6. *British Patent* No. 404, 855. 7, 8 & 9. To be published. 10. Narayanamurti, D., "Brush Treatments with Preservatives" to be published. 11. —, and Ranganathan, V., "Studies in Coal Tar Creosote as a Wood Preservative, Part II" to be published. 12. To be published. 13. Unpublished Report. 14. Narayanamurti, D., and Ranganathan, V., *Ind. For. Bul.*, 104. 15.—, Roy, D. C., "Some Leaching Tests on Ascu treated Timber" to be published. 16. —, and Purushotham, A., "Preservatives from Vegetable Oils" to be published. 17 & 17(*a*). Unpublished Report and Narayanamurti, D., *Ind. For. Bul.*, 114. 18. Narayanamurti, D., Purushotham, A., and Pande, J. N., "Studies on the Preservative Treatment of Bamboos, Part I" to be published. 19. —, *Ind. For. Bul.*, 110 & 111. 20. —, *Ibid.*, 119. 21. *Ind. For. Leaflet*, 49. 22. Narayanamurti, D., and Gopalchari, R., *Ind. For. Bul.*, 118. 23. —, —, "Some Experiments on Fire-retardant Treatments" not yet published. 24. —, and Ranganathan, V., *Ind. For. Rec.*, 2, 6. 25. —, and Purushotham, A., "The Specific Heat of Wood" not yet published. 26. —, *Ind. For. Bul.*, 105. 27. —, and Purushotham, A., *Ibid.*, 120. 28. —, *Ind. For. Rec.*, 3, 2. 29. —, and Kartar Singh, *Ind. For. Leaflet*, 42. 30. —, —, *Ibid.*, 45. 31. —, *Ind. Forester*, Aug. 1943 and Narayanamurti, D., and Kartar Singh, *Ind. For. Leaflet*. to be published. 32 —, Ranganathan, V., and Ikram, M., *Ind. For. Bul.*, 116. 33. —, —, and Basu Roy Chaudhuri, P. K., *Ind. For. Leaflet*, 15; Narayanamurti, D., and Kartar Singh, *Ibid.*, 16; Narayanamurti, D., Ranganathan, V., and Roy, D. C., "Adhesives from sunn-hemp seed proteins," *Ibid.*, 52; Narayanamurti, D., Ranganathan, V., and Roy, D. C., "Rape seed cake protein-formaldehyde Dispersions as Adhesives", *Ibid.*, 58; Ranganathan, V., and Roy, D. C., "Adhesives from Whole Meals and Seed Cakes", *Ibid*, 59. 34. —, —, *Ibid*, 10 & 40. 35. —, —, *Ibid.*, 41. 36. —, and Kartar Singh, "Tar Acid-formaldehyde Resin Adhesives" to be published. 37. —, Pande. J. N., and Roy, D. C., *Ibid.*, 6. 38. —, Kartar Singh and Roy, D. C., "Composition Boards from Waste Materials" to be published.

OBITUARY

P. ZEEMAN (1865–1943)

PIETER ZEEMAN, the famous Dutch Physicist, whose death has just been announced, was born at Zonnemain, Zeeland, in 1865. From 1885 to 1893 he studied at Leyden. In 1890 he became connected with the University as a privat-dozent and remained there until 1900 when he was appointed Professor at Amsterdam and later on Director of the Physical Institute. He made the great discovery known after him at the young age of 31, won the Nobel prize at the age of 37 and died at the age of 78. He was a member of many learned societies including the Royal Society and recipient of many degrees, medals, awards and numerous honours, and author of several papers and books.

Faraday had many years earlier, long searched for a relation between magnetism and light and had as early as 1862 placed a sodium flame in a magnetic field, observed the light in a spectroscope but found no effect. Faraday failed because his spectroscope did not possess the necessary resolving power and he did not use strong enough magnetic field. In 1896, Zeeman repeated Faraday's experiment with very strong magnetic fields and a powerful concave grating spectroscope and showed the splitting up of the spectral lines. The electron had just been discovered by J. J. Thomson and Lorentz on the basis of his theory of electrons supplied the explanation of Zeeman's great discovery. The normal triplets of Zn and Cd lines both with regards to their separation and polarisation were in complete accord with Lorentz's theory of electrons oscillating in atoms. The complex Zeeman effect of D lines and of green and blue lines of Zn and Cd which were soon after discovered by Zeeman and others were explained by Preston and Voigt and the discovery of the anomalous effect in the case of D lines by Paschen and Back in 1912 was further support and elucidation of the original theory. Bohr's theory of spectral lines was used by Debye and Sommerfeld in giving a newer explanation and opening up fresh fields of investigation. Lande's prediction of a multiplicity of stationary states and the hypothesis of orientation applied to multiplets and later on the hypothesis of the spinning electron and the introduction of the splitting factor and the most important work on the hyperfine structure and investigation of Bismuth lines by Goudsmit and Back in weak and strong magnetic fields, furnished the complete explanation of the Zeeman effect. If Zeeman effect had not been discovered the nature of spectral series would have remained problematic.

It is a remarkable fact that though nearly half a century has elapsed since the discovery of the original effect, Zeeman's work has kept pace with the latest developments of atomic physics. Originally explained in an elegant manner on the classical theory, its full importance and explanation have been furnished by quantum theory and its effect on the nuclear physics has been of great value.

Zeeman's experimental genius has achieved valuable results in other fields too and his work on gravitation and mass and inertia has been of great importance, especially in the theory of Relativity.

He and his students have contributed a great deal to the investigation of hyperfine structure of spectrum lines and Zeeman effect on these. This has resulted in the development of apparatus of the highest resolving power and the use of the highest experimental skill. Zeeman's influence spread far beyond his country and valuable contributions have come from all over the world.

The world of science has lost a great genial personality whose epoch-making discovery has inspired research of the highest type in experimental and theoretical physics for nearly half a century and has yielded results of the greatest value in understanding the nature of the spectrum lines and the structure of matter.

Lucknow,
December 23, 1943.

WALI MOHAMMAD.

STUDIES ON THE PRESERVATION OF GLANDS

III. The Preservation of Thyroid Glands

BY
B. B. DEY, P. S. KRISHNAN AND M. GIRIRAJ
(*Presidency College, Madras*)

THE thyroid gland, where the method of choice for medication is oral administration of the desiccated whole gland, offers an example *par excellence* of the principle of Organotherapy. This mode of medication presupposes a certain degree of stability on the part of the active principles towards heat treatment at moderately high temperatures and extraction with lipoidal solvents—two fundamental processes involved in the desiccation of the gland. The investigations that we have carried out on the changes undergone by the gland during storage under various conditions, go to show that the active principles of the gland possess a remarkable stability, in direct contrast to the Adrenal and the Pituitary glands.

It is now an established fact that the total organic iodine content is a better index of the biological potency of thyroid extracts than the thyroxine iodine content. Any deterioration undergone by the stored gland might, in part at least, be indicated by a decrease in the organic iodine content and a corresponding increase in the inorganic iodine. Assay of the acid-insoluble iodine, *i.e.*, the thyroxine fraction, would also be a valuable index, since it would indicate any decomposition undergone by thyroxine into acid-soluble physiologically inactive organic iodo-compounds. In the following table are represented values for total iodine, thyroxine iodine, inorganic iodine and organic iodine in desiccated specimens of thyroid glands which were stored under a variety of conditions, the various assays being carried out by methods described in the *British Pharmacopœa*. Assays were also carried on two specimens of whole gland extracts, one of which, a desiccated product, had been stored at room temperature since 1941 and the other, a dried-gland preparation, had been stored in the frigidaire since 1941, until it was removed in November 1943 for extraction of fat.

It will at once be apparent from the table that the figures for thyroxine iodine and organic iodine percentages are remarkably constant throughout, irrespective of whether the glands are chilled immediately in dry ice or transported to the laboratory in ordinary ice or whether they are stored at 0° C. for two days or frozen for one month. Even when the dried glands (both before and after removal of fat) are stored for two years, either at 0° or at 30°, the changes undergone by the extracts in chemical composition are, for all practical purposes, negligible.

	I	II	III	IV	V	VI	VII
		Thyroxine Iodine		*Inorganic Iodine*		*Organic Iodine* (by difference between I & IV average values	
	Total Iodine (% of desiccated gland)	(*a*) % of desiccated gland)	(*b*) % of total I_2 (average)	(*a*) % of desiccated gland	(*b*) % of *total Iodine* average	(*a*) % of desiccated gland	(*b*) % of total I_2
1. Cattle Glands brought to the laboratory chilled in 'dry ice' and desiccated immediately	0·997 0·994	0·397 0·397	39·86	0·0167 0·0161	1·67	0·980	98·33
2. Cattle Glands brought in ice and desiccated immediately.	0·917 0·922	0·374 0·374	40·65	0·0146 0·0149	1·60	0·905	98·40
3. Sheep glands treated as in 1.	0·691 0·680	0 286 0·285	41·46	0·0180 0·0197	2·68	0·671	97·32
4. Sheep glands treated as in 2.	0·623 0 630	0·254 0·268	41·62	0·0157 0·0157	2·59	0·611	97·50
5. Cattle glands stored at 0–50 for 2 days.	0·931 0·933	0·359 0·357	38·41	0·0245 0·0266	2·74	0·906	97·26
6. Glands (cattle) frozen for 1 week	0·954 0·968	0·353 0·355	36·84	0·0235 0·0210	2·71	0·930	97·29
7. Glands (cattle) frozen for 2 weeks.	0·953 0·958	0·364 0·378	38·81	0·0213 0·0202	2·17	0·935	97·83
8. Glands (cattle) frozen for one month.	0 888 0 885	0·352 0·359	40·14	0·0189 0·0190	2·07	0·868	97·93
9. Dried glands (cattle) stored at 0–5 for 2 years.	0·928 0·922	0·373 0·380	40·22	0·0226 0·0236	2·50	0·902	97·50
10. Desiccated glands (cattle) stored at 30°C. for 2 years.	0·923 0·939	0·357 0·385	39·86	0·0182 0·0203	1·80	0 912	98·20

The expenses of this investigation were met entirely by a grant from the Board of Scientific and Industrial Research, to whom our grateful thanks are due.

LETTERS TO THE EDITOR

DISTRIBUTION OF FISHER'S g_1 FOR SAMPLES OF THREE FROM A CONTINUOUS RECTANGULAR DISTRIBUTION

AN easy method to find out the distribution of Fisher's g_1 for samples of three from continuous populations appears possible from the following considerations.

Let x_1, x_2, x_3 be the sequence in which the three individuals are observed and let

$$\tau_i=\frac{x_i-\bar{x}}{s} \text{ where } \bar{x} = \tfrac{1}{3}\sum_{i=1}^{3} x_i$$

$$\text{and } s^2=\tfrac{1}{3}\sum_{i=1}^{3}(x_i-\bar{x})^2. \qquad (1)$$

It is easy to see that if the τ_i's are arranged in ascending order of absolute magnitude forming the sequence τ_1', τ_2', τ_3'

$$\text{then } 0 \leqslant |\tau_1'| \leqslant \frac{1}{\sqrt{2}}\,;\ \frac{1}{\sqrt{2}} \leqslant |\tau_2'| \leqslant \sqrt{\tfrac{3}{2}}\,;$$

$$\sqrt{\tfrac{3}{2}} \leqslant |\tau_3'| \leqslant \sqrt{2}. \qquad (2)$$

Also since

$$\sum_{i=1}^{3}\tau_i'=0\,;\ \sum_{i=1}^{3}(\tau_i')^2=3$$

$$\text{and } \sum_{i=1}^{3}(\tau_i')^3=\sqrt{\tfrac{3}{2}}\,g_1 \qquad (3)$$

we find that

$$g_1=\sqrt{6}\,\tau_i'\,(\tau_i'^2-\tfrac{3}{2}) \qquad (4)$$

and the distribution of g_1 can be determined once the distribution of τ_i' is known.

From the principles outlined elsewhere,[1,3] the distribution of τ_i' follows from the distribution of τ_i.

Also

$$\tau_i=\frac{\sqrt{2}\,\theta}{\sqrt{3+\theta^2}} \qquad (5)$$

where

$$\theta=\frac{x_i-\bar{x}'}{s'} \qquad (6)$$

$\bar{x}'$ and s' are respectively the mean and the standard deviation of the two observations left after excluding x_i. Hence if the probability distribution of θ is determined that of g_1 will follow immediately. This method is applied below, to get the distribution of g_1 for samples of three from a continuous rectangular distribution. The notation used above has been kept up all through this note.

RECTANGULAR DISTRIBUTION

Let

$$\left.\begin{aligned} p(x_i) &=1 \text{ for } 0 \leqslant x_i \leqslant 1\\ &=0 \text{ elsewhere}\end{aligned}\right\} \qquad (7)$$

So

$$p(x_i, \bar{x}', s') = 4$$

$$\left.\begin{aligned}&\text{for } 0 \leqslant x_i \leqslant 1\\ &0 \leqslant s' \leqslant \tfrac{1}{2}\,;\ s' \leqslant \bar{x}' \leqslant 1-s'\end{aligned}\right\} \qquad (8)$$

Also

$$p(\theta, \bar{x}', s') = 4s'$$

$$\left.\begin{aligned}&\text{for } -1\leqslant\theta\leqslant 1;\ 0\leqslant s'\leqslant\tfrac{1}{2};\ s'\leqslant \bar{x}'\leqslant 1-s'\\ &\text{for } 1\leqslant\theta\leqslant\infty;\ 0\leqslant s'\leqslant\frac{1}{1+\theta};\\ &\qquad s'\leqslant\bar{x}'\leqslant 1-\theta s'\\ &\text{for } -\infty\leqslant\theta\leqslant -1;\ 0\leqslant s'\leqslant\frac{1}{1-\theta};\\ &\qquad -\theta s'\leqslant \bar{x}'\leqslant 1-s'\end{aligned}\right\} \qquad (9)$$

$$\therefore\ \left.\begin{aligned} p(\theta) &=\tfrac{1}{6} \text{ for } -1\leqslant\theta\leqslant 1\\ &=\tfrac{2}{3}\cdot\frac{1}{(1+\theta)^2} \text{ for } 1\leqslant\theta\leqslant\infty\\ &=\tfrac{2}{3}\cdot\frac{1}{(1-\theta)^2} \text{ for } -\infty\leqslant\theta\leqslant -1\end{aligned}\right\} \qquad (10)$$

Since

$$g_1=\frac{\sqrt{3}\,\theta\,(\theta^2-9)}{(3+\theta^2)^{3/2}} \qquad (11)$$

it follows that

$$p(g_1)=\frac{(3+\theta^2)^{5/2}}{27\sqrt{12}\,(1-\theta^2)} \text{ for } -1\leqslant\theta\leqslant 1 \qquad (12)$$

which is equivalent to the two forms

$$\left.\begin{array}{l} p\ (g_1)=\dfrac{2\ (3+\theta^2)^{5/2}}{27\ \sqrt{3}\ (1+|\theta|)^2\ (\theta^2-1)} \\ \quad \text{for } -3\leqslant\theta\leqslant-1;\ 1\leqslant\theta\leqslant 3 \\ \quad \text{and} -\infty\leqslant\theta\leqslant-3;\ 3\leqslant\theta\leqslant\infty. \end{array}\right\} \quad (13)$$

Substituting

$$\theta=\sqrt{3}\tan\alpha \quad (14)$$

it is seen that these forms reduce to

$$p\ (g_1)=\frac{1}{\sqrt{12}\ \sqrt{3-g_1{}^2\cos^2\alpha}}$$
$$\text{for } -\sqrt{3}\leqslant g_1\leqslant\sqrt{3} \quad (15)$$

where α lies between $-\frac{\pi}{6}$ and $+\frac{\pi}{6}$ and satisfies the equation

$$\sin 3\alpha=-\frac{g_1}{\sqrt{3}} \quad (16)$$

NORMAL DISTRIBUTION

William R. Thompson (1935) has shown that

$$p\ (\tau_i{}')=\frac{1}{\pi\sqrt{2-\tau_i{}'^2}} \text{ for } -\sqrt{2}\leqslant\tau_i{}'\leqslant\sqrt{2} \quad (17)$$

$$\therefore\ p\ (g_1)=\frac{1}{\pi\ \sqrt{3-g_1{}^2}} \text{ for } -\sqrt{3}\leqslant g_1\leqslant\sqrt{3} \quad (18)$$

a result established by Fisher (1930).
Comparing the distributions of g_1 for the rectangular and normal distributions it is seen that

$$p\ (g_1) \text{ rectangular} \lesseqgtr p\ (g_1) \text{ normal}$$
$$\text{according as } |g_1| \lesseqgtr 1\cdot3887.$$

All-India Institute of Hygiene
and Public Health, Calcutta,
November 10, 1943. C. CHANDRA SEKAR.

1. Chandra Sekar, C., and Mary Francis, G., "A Method to get the Significance Limit of a Type of Test Criteria," *Sankyha*, 1941, **5**, 165–68. 2. Fisher, R. A., "The Moments of the Distribution for Normal Samples of Measures of Departure from Normality," *Proc. Roy. Soc., London*, A, 1930, **130**, 16–28. 3. Pearson, E. S., and Chandra Sekar, C., "The Efficiency of Statistical Tests and a Criterion for the Rejection of Outlying Observations," *Biometrika*, 1936, **28**, 308–20. 4. Thompson William, R., "A Criterion for the Rejection of Observation and the Distribution of the Ratio of Deviation to Sample Standard Deviation," *Ann. Math. Stat.*, 1935, **6**, 214–19.

ON DEFINING THE α-PHONEME

FOLLOWING Professor E. W. Scripture,[1] the term 'phoneme' is applied here to 'one of a group of similar speech sounds'. It is certainly a matter of fundamental importance to be able to define precisely the positive qualities (let us call them V and C) which characterise the vowel and consonant phonemes. Linguistics has not yet been able to arrive at these. It is because of this failure that Professor E. W. Scripture clearly points out the absolute necessity for a further work in *vowel analysis*; also, it is on account of this failure alone that certain phonemes are taken to be diphthongs which in reality turn out to be only long vowels in which the change is considerable.[2] Our normal expectation is that V and C must be mutually exclusive, *i.e.*, no sound-profiles can have both V and C. It is clearly seen from the phenomenon of the occurrence of the phoneme traditionally known as the *Aytam* in certain speech-forms in Tamil,[3] that V and C are not *exhaustive* characters of speech-sound-profiles. It is not true that a sound-profile must be either V or C. The *Aytam* is both not—V and not—C.

In the speech-forms where the *Aytam* occurs, it is preceded by a vowel (*the necessary condition*) and followed by a consonant (*the sufficient condition*). That is, in the actual articulation of certain Tamil words in the stream of speech, consisting of an integral part with a vowel, followed by a consonant, the *Aytam* occurs. In each such word, the sound-profiles which occur successively may be taken as an infinite class, densely ordered, which has initially the vowel-character, then a transitional character, and finally the consonantal character. For, a vowel is made up of a series of adjacent vibration profiles[4] the analysis of which show that all the frequencies from zero to infinity are present to a greater or less degree. 'The profile is, therefore, not a sum of a few discrete free vibrations as ordinarily supposed but an integration of an infinite number of such vibrations differing infinitely little from one another.'[5] Any spoken language consists of a succession of speech-sounds more or less overlapped[6] and these sounds can be grouped on the principle of similarity. The view that the speech is made up of a series of independent elements is erroneous.[7] 'Not only must we say that every individual sound changes from beginning to end but we must assert that each one develops out of the preceding sound and into the following one. There are no well-defined limits between neighboring sounds—not only because the limits are vague, but also because there are no independent sounds to be limited.'[8]

In this connection attention must be drawn to Professor Scripture's analysis of 'to race' (in plate VIII facing page 40). 'As the [t]-closure is opened, the vibrations appear in line 102. Are these weak vibrations to be reckoned to the vowel vibrations that occupy the rest of the line? Or are they to be treated as a "glide" from [t] to the vowel?' These are legitimate questions. But Professor Scripture does not appear to answer them. On the contrary, he appears to be merely to follow an arbitrary procedure in placing the beginning of the vowel at the point where the vibrations reach half a millimeter amplitude. Similar is his treatment with regard to other sounds as well (page 44). He himself admits that nowhere in the whole sequence is there any sudden change, nowhere any possibility of assigning limits. 'We must conclude that there are no such limits and that the sound changes gradually throughout.'

In this connection, it is interesting also to note that according to A. Tanakadate[9] the record of any single syllable of the Japanese sound elements, *e.g.*, that represented by the

Kana (*ku*) or (*ke*) presents three characteristic portions. The beginning corresponds to the consonant *k*, the end corresponds to the vowel *u*; and there is an intermediate portion between the two where the amplitude of the oscillations is reduced to an insignificant amount. This middle portion does not play any important part in the formation of sound quality, or the Japanese Phoneme. Cutting away this part or lengthening it artificially does not change the reproduced quality of the sound or sound value. The same holds when the consonant is followed by any other vowel.'

It must be also remarked here that a change-point is ordinarily conceived to be any point at which any organ changes from one type of function to another and an α-sound is also similarly conceived to be a segment between two successive change-points.[10] But an α-sound is quite different from the α-phoneme (the *Āytam*). The latter is a speech-sound of a group while the former is merely a sound. Failure to recognise this distinction will lead to much needless confusion. But it is clear that there are no ascertainable change-points. All the laboratory investigations lead to the conclusion that it is certain that there are no definite change-points. It is also clear that we are dealng with *macrophonic* speech here.[11]

If we know the defining characters V and C, then we could give a rigorous definition of the *Āytam* by means of Dedekind sections, namely, we have a Dedekind section in which the lower segment consists of V (*i.e.*, vowel sound-profiles) and the upper segment of not—V; we have also a second Dedekind section in which the lower segment is composed of not—C (non-consonantal sound-profiles) and the upper segment of C. The interval between the two section-points is the *Āytam* (the α-phoneme).

The *distances* bween the vowel, the α-phoneme and the consonant in each of our ordered classes have to be measured, and on the basis of the three *physical assumptions* stated already (in my paper on the sub-class of α-phoneme[12]) which are:—

(1) In the *transitional*, the vowel and the consonant are always together; there is superimposition.

(2) During the *transitional* as a consequence of superimposition the *masking effect* will be of importance.

(3) If the *duration* of the consonant extends beyond the refractory period there is a chance for the *audibility* of the consonant, in case the preceding vowel has an *influence* on the following consonant; the properties of the α-phoneme have yet to be experimentally studied. It needs no over-emphasis here that as some kind of accent distribution is involved in the occurrence of our α-phoneme, the relation between quantity and stress,[13] should not be lost sight of in our investigations.

The foremost advantage got by defining the α-phoneme can be easily seen to be the *conception* of a new 'bound' class (rather, a sub-class) of 'phoneme'.[14]

Althouh the definition of the α-phoneme has so far been restricted by me only to certain speech-forms in Tamil, still as we meet with phonetic features in another Dravidian dialect Gōṇḍī similar to those that characterise the production of the *Āytam* in Tamil, I need hardly say that the formulation of the 'cut' conception may open up an altogether new vista. In Icelandic, too, we meet with a phoneme under conditions similar to those under which the *Āytam* seems to have appeared in old Tamil. In Kashmiri dialects, too, there appears to be a similar phenomenon.

The phenomenon of the *Āytam* (the α-phoneme) is, therefore, a strong pointer to the possibility of defining vowel and consonant phonemes by certain (so far undiscovered) positive characters V and C.[15]

Phonetics Laboratory,
Deccan College Postgraduate
and Research Institute,
10, Connaught Road,
Poona 1, C. R. SANKARAN.
December 14, 1943.

1 *Nature*, 1935, **136**, 261 and 644. 2. Scripture, Prof. E. W., *Researches in Experimtntal Phonetics*, pp. 43–45. 3. Sankaran, C. R., *Bulletin of the Deccan College Postgraduate and Research Institute (BDCRI.)*, **2**, 348–49. 4. Scripture, Prof. E. W., *Nature*, 1932, **130**, 275. 5. Wood, Alexander, *Acoustics* **360**. See also Sankaran, C. R., *BDCRI.*, **4**, 124. 6. Scripture, Prof. E. W., *Nature*, 1935, **136**, 759. 7. —, *Ibid.*, 1935, **136**, 456. 8. —, *Researches in Experimental Phonetics*, pp. 42–43, 58–59; Andrade, M. J., *Language*, 1936, **12**, 2. 9. "A Study of Japanese Phonemes by means of Tone Films," *Proceedings of the Second International Congress of Phonetic Sciences*, 1936, **118**. 10. Hockett, C. F., *Language*, **18**, 5. 11. Scripture, Prof. E. W., *Nature*, 1933, **132**, 138. 12. Sankaran, C. R., *BDCRI.*, **4**, 55–56. 13. Heffner, R. M. S., *American Speech*, 1941, **16**, 204–7; Haugen, E., and Twaddell, W. F., *Language*, 1942, **18**, 230. 14. Sankaran, C. R., *BDCRI.*, **3**, 393. 15. I am indebted to Dr. R. Vaidyanathaswamy, Department of Mathematics, University of Madras, for the clarification of many ideas in the matter of application of Dedekind section idea in defining the α-phoneme.

RAMAN FREQUENCIES OF CALCITE

FOLLOWING the earlier work of Bhagavantam and Venkatarayudu,[1] one of us has recently given a satisfactory explanation for most of the prominent features of the Raman spectrum of sodium nitrate.[2] In this note, the case of calcite is dealt with on similar lines.

1065, 860, 680 and 1,407 cm.$^{-1}$ are assumed to be the normal frequencies of the CO_3-ion in solution and using the well-known equations for the frequencies of vibration in such a case, the following force-constants are evaluated: $K=5\cdot45\times10^5$, $K_1=1\cdot75\times10^5$, $K_2=0\cdot45\times10^5$, $K_3=3\cdot33\times10^5$.

In the crystal, besides altering the value of K_1 to $1\cdot86\times10^5$ so as to take account of the surrounding structure, three additional constants representing effectively all the inter-ionic and other forces of the crystal are postulated and their values are given below:

$K_4=0\cdot22\times10^5$, $K_5=0\cdot38\times10^5$ and $K_6=0\cdot16\times10^5$.

Taking the above values of the force-constants, the frequencies that are to be attributed to the $CaCO_3$ crystal can be evaluated as follows:

A_1 (Raman active, infra-red inactive)—1084.
A_2 (Inactive in both)—877, 213, 0.
B_1 (Infra-red active, Raman inactive)—890, 331, 106.
B_2 (Inactive in both)—1082, 297.
E_1 (Infra-red active, Raman inactive)—1487, 676, 403, 225, 139.
E_2 (Raman active, infra-red inactive)—1438, 703, 277, 141.

The significance of the various force constants and that of A_1, A_2, etc., is fully described in the paper already referred to and is not repeated here for want of space.

The results thus obtained are summarised and compared with the experimental observations in Table I:

TABLE I

Raman effect	Calc.: 141, 277, 703 1084, 1438. Obs.: 155, 282, 709, 1084, 1434.
Infra-red absorption	Calc.: 106, 139, 225, 331, 403, 676, 890, 1487. Obs.: 106, 106, 182, 357, 320, 706, 879, 1429–1492.

The agreement is good. The appearance of lattice lines in the Raman spectrum and of low frequencies in the infra-red absorption, the lack of exact coincidence between the Raman and infra-red frequencies in respect of the degenerate modes, a shift in the value of the total symmetric frequency from the ion to the crystal are amongst the features that are satisfactorily accounted for.

Dept. of Physics,
Andhra University,
Guntur,
January 7, 1944.

S. BHAGAVANTAM.
B. SUNDARA RAMA RAO.

1. *Proc. Ind. Acad. Sci.*, 1939, **9**, 224. 2. *Ibid.*, 1944 **19**, No. 1.

REFRACTION OF ULTRASONICS AND VELOCITIES IN COLOURED LIQUIDS AND IN SOLIDS

IN the Debye-Sears method of diffraction of light by ultrasonic waves, the intensity of lines on both sides of the central line is symmetrical only when the sound waves are exactly at right angles to the light beam. This phenomenon was used to measure the refraction of sound waves. The vibrating quartz was placed in a metal vessel having a plane mica window and containing a liquid, say xylol. The vessel containing the quartz was placed in a bigger plate-glass vessel containing a second liquid, say water. Through this vessel a monochromatic light-beam was sent for diffraction effect. Now by simple arrangements the quartz plate could be rotated through an angle without disturbing any of the vessels and[2] the assembly of the two vessels could be rotated as a whole through an angle without disturbing the quartz with respect to the vessels. This was done by fixing the whole arrangement for rotating the quartz on to one of the vessels.

To begin with, the plane of the quartz was set parallel to that of the mica window. In this position, the ultrasonics being incident normally upon the mica window would suffer no bending. The outer plate glass vessel was rotated till symmetry of intensity in the spectrum was obtained. The quartz was then rotated through an angle "*i*". "*i*" was then the angle of incidence. The outer vessel was again rotated till symmetry of intensity was obtained. Clearly the angle between the rotations of the other glass vessel was the angle of refraction. Two applications follow immediately, *viz.*, finding velocities in coloured liquids and in solids, transparent or opaque. The coloured liquid is of course to be put in the inner vessel. In case of the quartz cannot be set accurately parallel to the mica window, then more than two settings of the quartz can be used and corresponding refractions found. The method then becomes somewhat mathematically cumbersome. If the coloured liquid is electrically conducting, so that the quartz cannot be directly put in it then an innermost vessel can be put inside the inner vessel containing the coloured liquid. This innermost vessel has to be made of plate-glass and quartz put in it along with some non-conducting liquid, so that the plane of the quartz is always parallel to the side of the innermost vessel. This can be permanently set by cementing the quartz on to the inside of the vessel. The whole innermost vessel has now to be used in place of the quartz alone.

Solids.—A prism or wedge of the solid can be made having a small angle "*i*". The quartz can be cemented plane on one face of the prism containing the angle "*i*". In one way of using it, a permanent line can be drawn at the base of the plate glass-vessel (no inner vessel) and for convenience parallel to its breadth, and along the direction of the beam of the light. The prism is made to stand in the vessel, so that the quartz directly faces the side of the liquid exposed for diffraction, the side of the prism being directly on the line. The vessel is now rotated till symmetry of intensity is obtained. The prism is then turned over, the other face of the prism containing "*i*" being on the ruled line. The waves have now to pass the prism in order to come to the part of the liquid used for diffraction. "*i*" then becomes the angle of incidence. The vessel is again rotated to get symmetry of intensity. The angle between the two rotations is the angle of refraction.

Accuracy.—The accuracy by this new method depends upon the accurate measurement or setting of the following:—

(1) Position of the crystal when intensity is symmetrical.
(2) Plane of the crystal parallel to the plane of the mica window. Of course any other suitable substance can also be used in place of mica, say glass.
(3) Angles of incidence and refraction.

As regards (1), Parthasarathy (1936) found

that rotation of the crystal through six minutes, completely changed the intensity from symmetrical to unsymmetrical. It seems from his paper that still lesser angles can be detected. For 2, among others, a screw-arrangement can be made for moving the crystal right up to the separation window, making the crystal flush with the window by proper rotation and then taking the crystal back. As already mentioned this setting can be dispensed with at the cost of mathematical computation.

Lahore,
September 16, 1943. R. PARSHAD.

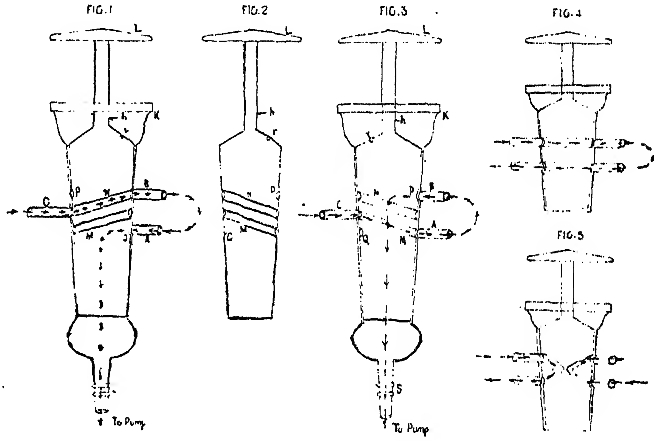
Parthasarathy, *Proc. Ind. Acad. Sci.* (A), 1936, **4**, 213.
Bergmann's *Ultrasonics*.

A REVERSIBLE FOUR-WAY STOP-COCK USEFUL IN WORK CONNECTED WITH CIRCULATION OF GASES AND LIQUIDS

WHILE engaged in work connected with the measurement of the period of decay of active nitrogen the need for a four-way stop-cock capable of controlling the inlet and outlet of a chamber through which the gas is streaming was keenly felt. By suitable modifications in the existing three-way stop-cocks the author found that the above difficulty could be overcome, as also the stop-cock could be made a reversible one. As the new stop-cock proved of considerable use and as it would be of interest to workers in this and allied fields for circulation of gases and liquids, a short description of the stop-cock is given below along with a diagrammatic sketch of its working.

In Fig. 1 is shown an ordinary three-way mercury-sealed glass stop-cock. The plunger L is a hollow cylinder ground to fit the outer socket K. Two small glass tubes M and N are fused internally in L such that the side arm C of K could be connected with either A or B by proper manipulation of L. Normally S is closed with a pressure rubber tube fixed to a glass rod and mercury is poured into K when it fills up the hollow space in L through the hole *r* and covers the plunger a little above *r*. This so-called mercury-sealing gives further resistance to the entry of outside air into the stop-cock which the normal grease is unable to stop. Such a stop-cock can be easily converted into a four-way stop-cock. Bore a hole Q carefully through the wall of the plunger L so that when C makes connection with B, A is in communication with the hollow space in the plunger through the hole Q. The small hole *r* referred to above can be closed with sealing wax or any other cementing material. As an additional precaution mercury may now be poured above it to a small depth. S is extended by fusing an ordinary glass tube. Thus the stop-cock has now four arms, S, A, B and C. Supposing C is connected to the inlet of a gas reservoir and the chamber to A and B, and S to any suction pump. The gas now passes through from C into the chamber through N and leaves it through A and S, through the hole Q. The path of the streaming gas is shown in Fig. 1 by arrow marks. When the plunger L is now turned through 90° the inlet and outlet to the chamber are cut off and the gas is imprisoned in the chamber.

In order to reverse the direction of the flow of the gas in the chamber in position, *i.e.*, without changing the relative positions of the reservoir connected to C and the suction pump connected to S, bore another hole through the wall of the plunger L at a place P such that when C is in connection with A through M,



P connects B with S through the plunger. This is shown in Fig. 3. Now the gas passes through the chamber in the reverse direction as shown by the arrow marks. When the stop-cock is now turned through 180° the direction of the flow of gas through the chamber is once again reversed (*cf.* Fig. 1). The plunger with the proper holes P and Q bored as described above is shown in Fig. 2.

Thus the new type of four-way reversible stop-cock can be made by modifying the existing three way stop-cock as described above. If, however, the reversibility referred to above is not essential then the simpler types of four-way stop-cocks diagrammatically shown in Figs. 4 and 5 may conveniently be employed. The use of such four-way stop-cocks in work connected with the adsorption of gases and vapours by solids, decomposition of gases under electric discharges in ozonisers and other similar discharge tubes, measurement of the period of decay of after-glows, in interferometric work with gases, etc., wherein circulation of gas is of considerable importance, cannot be overestimated.

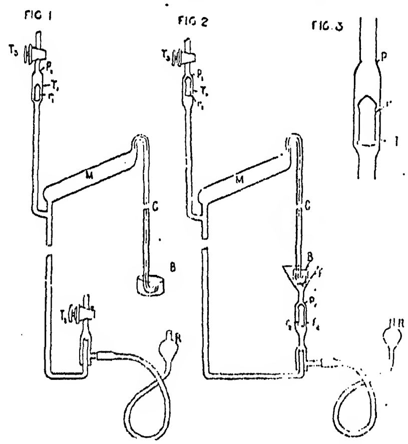
The author takes this opportunity to express his grateful thanks to Dr. S. S. Joshi, M.SC., D.SC. (Lond.), University Professor of Chemistry, of the Benares Hindu University, who gave him facilities to conduct the work.

Forest Research Institute,
Dehra Dun,
September 10, 1943. A. PURUSHOTHAM.

SOME IMPROVEMENTS TO THE TOPLER PUMP

THE two main difficulties generally experienced in the working of a Töpler pump (Fig. 1) are (1) the leakage of mercury through the stop-cock T_2 under the pressure of the mercury in the reservoir when the latter is raised to push out the gas from the main body M of the pump through the capillary C, in spite of all usual precautions being taken and, (2) the very careful attention to be paid by the worker in transferring again and again the excess of mercury, thrown out through the capillary C during the working of the pump, into the reservoir R. Neglect of the latter results in the overflowing of the mercury from the basin B. To avoid both the above-mentioned difficulties the modification devised by the author has been found satisfactory in use.

The modification adopted is simple and consists in putting in a ground-in trap T_2 (Fig. 2, similar to the one used in the inlet to the pump, *i.e.*, T_1) in place of the stop-cock T_2 (Fig. 1). This is shown in detail in Fig. 3.



To the end of this trap is fused an ordinary funnel F (Fig. 2) such that the basin B which receives the mercury flowing through the capillary C, seats itself comfortably over a base (say a pipe clay triangle) placed inside the funnel. This is shown in Fig. 2. The function of this trap T_2 like the Trap T_1, is to close the passage to the mercury when the reservoir is lifted up in the course of the evacuation of the gas contained in the body M of the pump. This is achieved by the pushing up of the ground-glass hollow cylinder r_2 gradually against the ground-in passage P_2 by the rising mercury in the trap T_2. The mercury now flows up the body M of the pump displacing the gas completely through the capillary C. When the reservoir is lowered the ground-glass cylinder r_2 recedes along with the mercury column thus enabling the excess of the mercury overflowing the basin B to go down automatically into the reservoir through the trap T_2. Thus the addition of the trap T_2 as described above not only eliminates the stop-cock T_2 (Fig. 1) along with the other difficulties consequent on its use (outlined above), but also obviates the necessity of transferring into the reservoir the mercury overflowing the basin, which need be done rather very often with the normal type of the pump.

The author wishes to place on record his grateful thanks to Dr. S. S. Joshi, M.Sc., D.Sc. (Lond.), University Professor of Chemistry, of the Benares Hindu University, who gave him facilities to conduct the work.

Forest Research Institute,
Dehra Dun, A. PURUSHOTHAM.
September 10, 1943.

CHROMOSOME NUMBER OF *CARICA DODECAPHYLLA* VELL FL. FLUM

THE chromosome number of *Carica pubescens* Lenne and Koch, a strictly dioecious species was reported in a previous note[1] to be $2n = 18$ and it was pointed out that the somatic complement showed no heteromorphic pair of chromosomes to distinguish the two sexes. During further investigations on the cytology of *Carica** the chromosome number and their characteristics of *C. dodecaphylla* Vell. Fl. Flum which is also a strictly dioecious species have been determined. Cytological examination of about fifteen metaphase plates from about ten root-tips revealed the diploid number to be eighteen in this case also. No marked differences are discernible between the somatic compliments of *C. dodecaphylla*, and those of *C. pubescens* and *C. papaya*. Besides, the position of attachment constriction is the same, namely, median or sub-median in the above three species of *Carica*. Distinctly heteromorphic pair of chromosomes could not be noted. The absence of a heteromorphic pair of chromosomes in *C. pubescens* and *C. dodecaphylla* and the similarity of chromosomes of these and other investigated species of *carica* appear to further support the view expressed by Storey (1941) of close relationship among them.

Our thanks are due to His Majesty's Consul-General at Buenos Aires, for seeds of *C. dodecaphylla*.

College of Agriculture,
Poona, L. S. S. KUMAR.
December 23, 1943. V. K. SRINIVASAN.

1 Kumar, L. S. S., and Abraham, A., *Curr. Sci.*, 1941, **11**, No. 2, 58. 2 Storey, W. B., *Hawaii Ag. Expt. Station Bull.*, 1941, No. 87, 6-7.

* Scheme for research on the "Cytology of *Papaya*," financed by the Imperial Council of Agicultural Research, New Delhi.

A NEW GENE FOR LINTLESSNESS IN ASIATIC COTTONS

THE appearance of lintless mutants in Asiatic cottons has often been reported and their genetic behaviour described by different workers in India. In 1940, the writer came across one such mutant in the Broach 9 (*G. herbaceum*) seed multiplication area at the Baroda Agricultural Experimental Station. The mutant is characterised by a hairy plant body and a

thickly fuzzy seed-coat. It is thus similar in appearance to another lintless mutant which was discovered in 1932 in miscellaneous herbaceum material at Broach and the seed of which was kindly supplied to the writer by Mr. G. B. Patel, Cotton Breeder, Viramgam. The Baroda mutant was crossed with this and other known lintless mutants, in order to study its genetic relationships. The results obtained so far are briefly given below.

Baroda lintless × Broach 9 linted: The F_1 was linted. A single F_2 family consisting of 125 plants gave 96 linted: 29 lintless. On a 3 : 1 basis, the fit is good ($x^2=0\cdot216$, $P=0\cdot5-0\cdot7$) and represents a single-factor segregation.

Baroda lintless × Viramgam lintless: F_1 was lintless and resembled the parents. In a single F_2 family of 147 plants, all plants were lintless like the parents. The same gene is thus responsible for lintlessness in both these types.

Baroda lintless when crossed with 1027 A.L.F., 1027 A.L.F. × Wagad, Dharwar, Nagpur, Mollisoni, Punjab glabrous and Nandyal lintless types gave a linted F_1, showing that the Baroda gene is distinct from these other mutants and complementary to them. In its cross with the Punjab hairy lintless, Baroda lintless gave a lintless F_1; but that these two genes are different is seen from the fact that in common crosses with 1027 A.L.F., 1027 A.L.F. × Wagad and Nagpur lintless, the Punjab hairy lintless gave a lintless F_1 whereas the F_1 with Baroda lintless was linted as stated above.

It is clear from these results that Baroda and Viramgam lintless represent independent mutations at the same locus and that they are distinct from other lintless types and complementary to a majority of them. The factor pair corresponding to the new mutant and the normal may be designated as $Li_d - il_d$. Further work to study the linkage relations of the gene is in progress.

Economic Botanist,
Baroda, G. K. Govande.
October 6, 1943.

REGENERATIVE CAPACITY IN *PERIONYX SANSIBARICUS* MICHAELSEN (1891)

This earthworm, which is rather widely distributed in India from Allahabad to South Malabar, has been known hitherto only from preserved museum material. Through the kindness of W. B. Hayes, who furnished the specimens, and of I. D. Caleb, who provided the opportunity and facilities for the work, it has now been possible to study live individuals.

The species appears to have an unusually high regenerative capacity for an earthworm and to indicate in a preliminary way that capacity is the purpose of this note.

Worm 1.—A posterior portion (substrate) developed at intersegmental furrow 81/82, in 3 weeks, a head of 16 segments which was then removed. After this operation the substrate autotomized the last 15 segments. The remainder of the original substrate, in the next 11 days, regenerated a second head, this time of 13 segments, and a small tail 1½ mm. long. After removal of both ends, a piece now comprising only segments 88-122 of the original substrate, formed in 12 days at the anterior end a head of 14 segments, 3 mm. long, and at the posterior end a tail of 6 setigerous segments (and anal growth zone) 1 mm. long. The tail piece autotomized from the original substrate, survived but during the combined periods of development of the second and third heads, was able to produce at its anterior end only a single anal segment with no growth zone.

Worm 2.—A posterior substrate developed at 50/51 in 15 days a head of 17 segments. The new head and first four segments of the original substrate were then removed and the remainder divided into three pieces: (*a*) segments 55-113; (*b*) segments 114-143; (*c*) segments 144-163. In 15 days the (*a*) piece, now only 20 mm. long, produced a head 3 mm. long of 14 segments, and a tail 1½ mm. long, of 7 setigerous segments. The (*b*) piece, in 8 weeks, produced only a single anal segment at each end, while the (*c*) piece (5 weeks) formed only a single anal segment at the anterior end.

Worm 3.—A substrate comprising segments 21-50 autotomized the last 8 segments (which died) and then regenerated in 18 days a head 4½ mm. long of 16 segments, and a tail of 18 setigerous and pigmented segments. Head and tail regenerates with proximal 4 and 3 substrate segments were removed and discarded. In 26 days the remaining portion, now only 5 mm. long and of 13 segments, regenerated at each end a head, the anterior head 2½ mm. long with 13 segments, the posterior head 1½ mm. long and of 9 segments. The posterior portion of the original worm, segments 51-159, produced in 3 weeks at the anterior end, a head 6 mm. long of 19 segments.

Worm 4.—A substrate comprising segments 41-65 produced in 21 days a head of 4 mm. long of 17 segments, and a tail 7 mm. long. The substrate now comprised only 23 segments, 2 having been dedifferentiated and incorporated into the head and/or tail.

Worm 5.—This worm escaped and the next noon was found about 3 inches from its container, coiled up in full glare from a bright sky. The body was stiff but not brittle. The worm was placed in water. After a few moments the anterior half began to jerk back and forth but these movements soon ceased. The next day anterior and posterior portions were not only dead but decayed. There was no sign of autotomy. Dead parts were trimmed off. The remainder, of 22 segments, survived and regenerated a head of 13 segments as well as a tail 2½ mm. long.

Ewing College,
Allahabad, G. E. Gates.
November 12, 1943.

RESPIRATORY MOVEMENTS IN CARP FINGERLINGS

Reduction in oxygen in a medium invariably causes the fish to come to the surface and gasp for air. Their breathing on such occasions is always rapid. Whenever such a phenomenon has been observed, whether in a tank or in an aquarium, the test has always revealed either the presence of toxic substance or diminished

dissolved oxygen in the medium. Belding (1929)[1] pointed out that "the respiratory movements are an important aid in the diagnosis of fish disease and in differentiating the reaction of fish to a toxic environment". The respiratory movements of fish have not so far been utilized in this country for the differential diagnosis of fish ailments or toxic environments.

During the course of an experiment on the oxygen requirements of the carp fingerlings (Hamid Khan, 1940)[2] it was observed that the fry at the commencement of the experiment settled down at the bottom of the container with certain regularity in their respiratory movements as indicated by the opening and closing of their operculum, but as the oxygen became reduced, the fry came to the surface breathing rapidly and gasped for the air. Investigation of the rate of their respiratory movements gave some interesting results which are presented in this article.

Method

The carp fingerlings, namely, Rohu, *Labeo rohita* (Hamilton) and Mori, *Cirrhina mrigala* (Hamilton), measuring 5 to 6·5 inches from tip of the snout to the base of the caudal fin, were confined in air-tight containers with a capacity of 8·17 litres each. Two fry were put in each container, which was filled with fresh water to the top and stoppered to avoid air contamination. The respiratory movements of the operculum were observed with a stop-watch for one minute after interval of every twenty minutes till the fish showed signs of suffocation. The temperature of water in the experiment performed during October ranged from 72° F. to 75° F., while in the experiment

TABLE I

Respiratory movements of carp fingerlings, Cirrhina mrigala *(Hamilton) and* Labeo rohita *(Hamilton)*

Serial No.	Species of Fish	Interval in minutes after confinement											Remarks
		5	25	45	65	85	105	125	145	165	185	205	
	(i) Rate of respiration per minute when temperature ranged from 72° F to 75° F												
1	*Cirrhina mrigala*	70	70	75	85	121	143	159	134	..	..	..	Fish overturned, taken out
2	Do.	89	85	87	115	140	156	170	150	..	..	..	
3	Do.	65	75	75	82	88	94	124	148	..	..	..	Fish taken out
4	Do.	78	94	90	96	99	105	140	202	..	..	..	
5	Do.	74	74	76	81	103	93	98	102	142	183	114	Fish overturned, taken out
6	Do.	54	56	56	64	70	76	80	91	130	160	120	
7	Do.	72	72	76	94	134	165	164	94	..	..	..	Do. do.
8	Do.	80	82	93	118	152	186	173	62	..	..	..	
9	*Labeorohita*	85	91	95	98	99	113	123	148	..	..	..	Fish comfortable, taken out
10	Do.	121	131	142	15[illegible]	160	165	170	175	..	..	..	
11	Do.	83	80	106	104	126	161	166	93	..	..	..	Fish overturned, taken out
12	Do.	76	78	103	114	132	178	174	93	..	..	..	
	(ii) Rate of respiration per minute when temperature ranged from 80° to 87°												
1	*Cirrhina mrigala*	161	167	200	242	258	212	165	..	..	..	..	Overturned, died
2	Do.	206	213	228	256	272	226	188	..	..	..	..	Do.
3	Do.	160	144	164	210	250	270	281	..	..	..	..	Fish taken out
4	Do.	145	120	150	160	220	250	270	..	..	..	..	Do.
5	Do.	140	167	180	215	225	190	..	..	..	..	..	Do.
6	Do.	118	124	135	148	150	168	185	..	..	..	..	Do.
7	Do.	116	142	158	177	197	188	190	..	..	..	..	Do.
8	Do.	175	170	166	180	190	190	132	..	..	..	..	Do.
9	Do.	152	150	158	182	184	198	138	..	..		..	Do.
10	Do.	112	130	148	147	165	190	175	168	..	..	..	Do.
11	Do.	147	136	198	206	214	..	..	..	..	..	..	Do.
12	Do.	146	150	194	202	180	..	..	..	..	..	..	Do.
13	Do.	152	172	206	208	202	..	..	..	..	..	..	Do.
14	Do.	132	150	160	172	184	190	206	195	..	..	..	Do.
15	Do.	132	130	196	224	230	185	..	..	..	..	..	Do.
16	Do.	108	122	170	198	232	..	..	..	..	..	..	Do.
17	Do.	120	146	180	200	220	214	..	..	..	..	..	Do.
18	*Labeorohita*	150	..	217	242	270	254	..	..	..	..	..	Do.
19	Do.	127	147	158	177	183	200	166	167	..	..	..	Do.
20	Do.	164	142	232	220	196	..	..	..	..	..	..	Do.
21	Do.	160	172	208	222	160	..	..	..	..	..	..	Do.
22	Do.	132	170	210	210	206	142	..	..	..	..	..	Do.
23	Do.	140	170	210	220	242	180	..	..	..	..	..	Do.
24	Do.	124	130	196	212	240	196	..	..	..	..	..	Do.

TABLE II

Gaseous contents, temperature and pH value of the medium

Serial No. of experiments as in Table I (*i*) from 1–12	Before the experiment						After the experiment						Remarks
	Gases c.c. per litre				Temperature	pH	Gases c.c. per litre				Temperature	pH	
	Carbon dioxide			Oxygen dissolved			Carbon dioxide			Oxygen dissolved			
	Free	Half bound	Fixed				Free	Half bound	Fixed				
1–2	1·769	23·257	23·257	5·23	73°F	8·2	5·561	22·752	22·752	·4206	72°F	7·4	Fish overturned and taken out
3–4	..	19·71	23·763	5·505	74°F	8·1	8·083	14·915	14·915	·686	75°F	7·2	Fish taken out
5 6	..	23·514	25·532	7·342	74°F	8·1	5·814	23 763	23·763	·229	74°F	7·3	Fish overturned and taken out
7–8	..	23·514	25·532	5·79	74°F	8·1	4·769	25·785	25·785	·274	72°F	7·5	Do.
9–10	..	19·71	23·763	5·505	74°F	8·1	1·769	23·257	23·257	·703	75°F	7·6	Fish quite comfortable and taken out
11–12	..	22·75	25·785	6·33	73°F	8·2	3·539	25·027	23·027	·371	74°F	7·3	Fish overturned and taken out

conducted in May, the temperature ranged from 82° F. to 87° F. The fry when introduced into the container were allowed to rest for five minutes because breathing was rapid in the beginning due to exertion as the fish darted from one corner to another before they settled down. Sufficient care was taken by the observer to be unnoticeable to the fish as a slight noise or movement would make the fish dart and strike against the container. A control was kept during the period of experimentation. The experiments were started at the same time each day.

RESPIRATORY MOVEMENTS

The rate of respiratory movements per minute in the two species is shown in Table I. The gaseous contents of the medium, its temperature and its pH value for the experiments when the temperature ranged from 72° to 75° F. are given in Table II. It was observed that the rate of respiration, when the temperature was low, was slow and the fish lived in the medium from 145 to 205 minutes. But when the temperature ranged from 82° to 87° F. the breathing, even from the commencement of the experiment, was quite rapid and most of the fish did not survive after 125 minutes and only a few lived upto 145 minutes.

The tests, further, showed that with the reduction of oxygen in the medium there was a gradual increase in the respiratory movements of the fish. With further decrease in the oxygen the movements showed a decline which ultimately ended in the suffocation of the fish. The fish, taken out of the container immediately when the fall in the respiratory movements was noticed, revived when put in fresh water, but those left in the container overturned and died.

It may, therefore, be said that upto a certain limit, *i.e.*, 0·686 c.c. p.l., dimunition in the dissolved oxygen in the medium is tolerated by the fish irrespective of cabon dioxide concentration, and its respiratory movements increase to compensate for the lack of oxygen. But when the oxygen is reduced to 0·229 to 0·371 c.c. p.l. in the medium the respiratory movements slow down and ultimately result in the asphyxiation of the fish.

Office of the Game Warden,
Punjab, Lahore,
October 19, 1943.
HAMID KHAN.
AMJAD HUSAIN.

1. Belding, D. L., *Trans. Amer. Fish. Soc.*, 1929, **59**, 238–45. 2. Hamid Khan, *Ind. Journ. Vet. Sci. Anim. Husb.*, 1940, **10**, 372–81.

GROWTH STAGES OF *LYSIOSQUILLA TIGRINA* NOBILI

THE present communication is a continuation of the studies on the Stomatopod larvæ of the Madras Coast already published in *Current Science* (Alikunhi and Aiyar, 1942, '43). *Lysiosquilla tigrina* Nobili is a very rare species, and to my knowledge is known only from the type specimen. Nobili obtained a single male specimen, 45 mm. long, from Santubong, Borneo, which was redescribed by Kemp (1913). The larvæ of this species are very rare as only two specimens could be obtained, one picked out from the preserved plankton of 14-3-1939 after an examination of seven years' plankton collections and the other obtained in the living condition from plankton of 3-3-1943. The latter developed into a female.

Final Pelagic Larva.—Total length including rostrum 13·5 mm., length of rostrum 4·3 mm., median length of carapace, excluding rostrum 4·5 mm., breadth of carapace in front of postero-lateral spines 2·3 mm., length of postero-lateral spine 3·2 mm., length of telson 1·3 mm., breadth of telson 1·7 mm.

Carapace slightly broader than the abdominal segments and extends over first abdominal. Antero-lateral corners smooth without any indication of the antero-lateral spines (Fig. 1*a*). Zoea spine absent. Rostrum long, with three ventral spinules. Tips of postero-lateral spines reach hind end of telson; each spine with a ventral spinule at base. Antennular peduncles short, flagella hardly reaching middle of rostrum. Eyes large with short eyestalks. Raptorial propodus with a short stout spine proximally. Dactylus has no free spines besides the terminal. 'Hands' of the third and fourth thoracic appendages large; that of fourth

about twice the size of that of third. Abdominal segments very much broader than long; postero-lateral corners smooth and rounded. Telson broader than long with broad submedian area. Of the three pairs of marginal spines the submedians are the largest (Fig. 1b). One lateral and two intermediate denticles present on each side. The submedian area is marked out into three regions. Five small

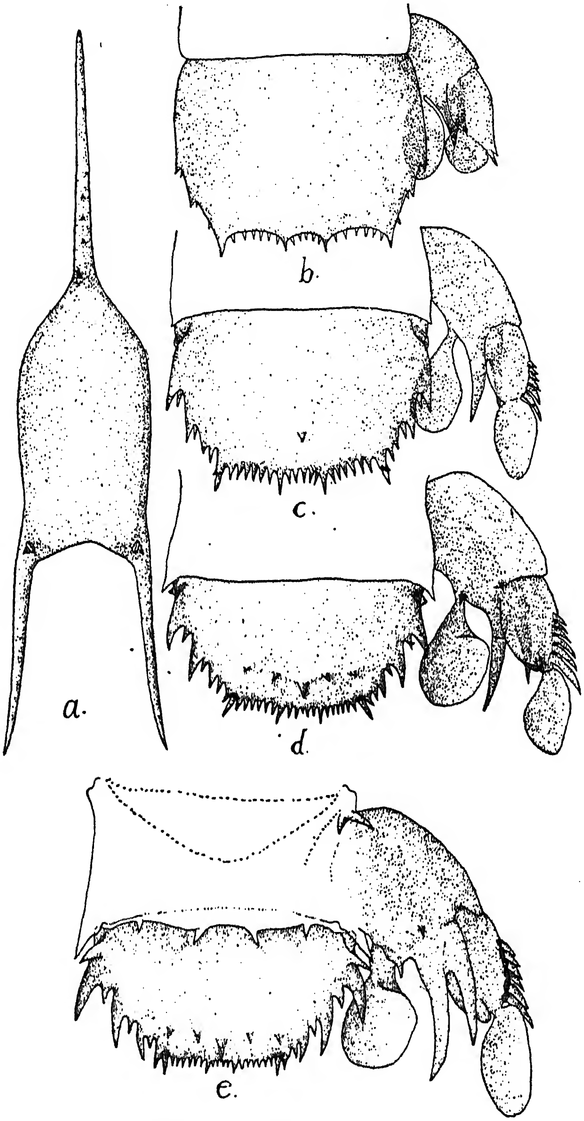


FIG. 1. *Lysiosquilla tigrina*

(*a*) Carapace of Final Pelagic Larva × 10; Telson and Uropod of; (*b*) Final Pelagic Larva × 25, (*c*) Early Post Larva × 25; (*d*) Young specimen after first moult × 25; (*e*) Same after 2nd moult × 25; (Diagrams made with camera lucida).

denticles in the central area and six in each of the lateral areas are present (6 + 1 + 5 + 1 + 6). Exopod carries two free spines; outer spine of ventral prolongation smaller than the inner.

Colouration.—Carapace with two pairs of yellow pigment spots, first pair at the level of the raptorial limbs and the second near the base of the postero-lateral spines. 'Hands' of third and fourth thoracic limbs bright yellow. Sixth abdominal segment with a small group of yellow chromatophores on either side at the base of uropod.

The absence of the zoea spine and the antero-lateral spines of the carapace, the number and arrangement of the submedian denticles of telson are features that distinguish this form from allied Lysierichthii. The post-larval stage is reached overnight after rapid moulting and metamorphosis.

Early Post-Larva.—Total length 9 mm. It is a pale-white actively swimming creature. There is a slight reduction in length consequent on the shortening of the thoracic region during metamorphosis. Eyes prominent; rostrum bluntly pointed; raptorial dactylus with 10–11 teeth. Sixth abdominal somite with small sub-acute spines at postero-lateral corners. Telson has become shorter; with marginal spines long and pointed. Submedian spines movably articulated. Intermediate denticles three in number. Submedian denticles same as in larva. A single median dorsal spine near distal margin of telson (Fig. 1c). Uropod longer than in larva with six spines on outer aspect of basal segment of exopod; Outer spine of ventral prolongation a trifle shorter than the inner.

Eight moults were observed, the first being eight days after metamorphosis, the whole time being 81 days, after which the specimen died. The intervals between the moults were 8, 7, 7, 10, 10, 12 and 19 days respectively. The length of specimen after each moult was 11, 13, 15, 18·5, 22, 25, 28·5, 29·7 mm. respectively. During the moults the carapace, abdomen, telson and uropod are the structures affected as shown by the change of shape of rostrum, the increase in the number of spines at the hind inferior border of the last abdominal segment and the development of the spines characteristic of the adult on the sides of the telson. Figs. 1d and 1e show some of these changes. The colour pattern so characteristic of the species is indicated after the second moult in the form of three transverse bands on the carapace, by an inconspicuous brown transverse band on each of the last four thoracic segments and on each of the first four abdominal segments. After the third moult colour pattern becomes better defined. Gradually the bands on the exposed thoracic segments become wider and the anterior pigment bands of some of the abdominal segments more clear, while there is a tendency for the bands to fuse, which becomes more pronounced in subsequent moults.

Fuller details will be given in a comprehensive paper under preparation.

My grateful thanks are due to Prof. R. Gopala Aiyar for his valuable help and criticism. I am also indebted to Prof. P. Narayana Menon and Messrs. M. Krishna Menon and R. Velappan Nair for their helpful suggestions.

University Zoology Research
Laboratory, Madras,
Dept. of Natural Science,
Maharaja's College, Ernakulam,
December 10, 1943. K. H. ALIKUNHI.

Alikunhi, K. H., and Aiyar, R. G., "On some *Squilla* larvæ from the Madras Plankton," *Curr. Sci.*, 1942, **11**, No. 2; "Growth in Some Stomatopods", *Curr. Sci.*, **1943**, **12**, No. **3**; Kemp, S., "An Account of the Crustacea Stomatopoda of the Indo-Pacific Region," *Mem. Ind. Mus.*, 1913, **4**.

REVIEWS

Modern Synthetic Rubbers. By Harry Barron. (Chapman and Hall Ltd., London), 1942. Pp. viii + 274. Price 25/-.

The appearance of this book is most opportune. With the rubber cultivation of the world in enemy hands, the need for a synthetic rubber industry in Great Britain and in the Empire, particularly in India, is most vital. Dr. Barron has, therefore, rendered yeoman service by bringing out this book and although the get-up of the book and the treatment of the subject-matter could have been better, the fact that "all too often the pen has to be laid aside at the behest of the more urgent and irresistant call of the air-raid siren" explains fully that war-time economy and the strife of life under war conditions are responsible for the minor shortcomings one notices. The book is one which ought to be in all scientific and technical libraries and in the hands of all workers interested in rubber and plastic materials in general. As is well known to workers in these fields, the meanings attached to the word rubber have changed. Rubber no longer signifies merely a particular hydrocarbon material. In order to qualify as a rubber, the material should be able to be stretched readily to a considerable degree and after release return forcefully and quickly to almost its original size and shape.

The contents of the book have been divided into three parts. Part I deals with general considerations regarding natural rubber and synthetic-rubber-like materials. Part II takes into consideration the chemical and physical background of synthetic elastic materials and includes in it the question of terminology, historical background, chemical behaviour and structure of natural and synthetic rubber, raw materials, polymerisation, copolymerisation and emulsion and polymerisation.

Part III deals with the technology of synthetic elastic materials and elastomers; *S.K.B.* and *Bunas, perbunan, hycar O.R. chemigum* and *neoprene* have been fully dealt with. Polybutylene and butyl rubber are treated under the title "Elastenes". This is a new word coined by the author to denote the materials employed for the manufacture of rubber-like substances which are based on olefines and are virtually saturated. Thioplasts and ethenoid elastics have been given adequate treatment occupying 34 pages of the book (213-247). A whole chapter has been devoted to comparative properties of elastics which makes the book exceedingly useful from the practical point of view. These properties have been fully explained and in some cases, they are even diagrammatically brought out. A table has been provided to bring out the property of chemical resistance at 20° C. and is of great value to those who are interested in the application of synthetic rubber to container-problems.

The most remarkable feature of the book is the rather up-to-date information on the physical properties of the synthetic rubber. The X-ray diagrams showing the structure in the stretched and unstretched condition are excellent, and are a great help in understanding the fundamental properties of synthetic rubber. It would have been useful if the author devoted a few pages to numerous plants other than the usual one from which the rubber latex is collected. This has been omitted largely because the treatise really deals at great length only with synthetic rubbers.

The reviewer is of the opinion that the synthetic rubbers have come to stay. Several properties which they possess make them indispensable to trade and industry. It will be a wrong policy for the British people and for us in India not to devote more attention to synthetic rubber because we can grow natural rubber. The natural rubber itself can be improved by admixture with plasticisers and synthetic rubber.

I must end by congratulating the author for producing this extremely useful and readable volume. The subject-matter is treated accurately and is not too difficult for a works-chemist who may not be familiar with the latest physical and chemical technique.

S. S. B.

A Junior Book of Physical Chemistry. By Dr. I. D. Shiva Rao. (Published by Jayantilal Vithaldas, Surat), 1943. Pp. 220 + vi + 7. Price Rs. 5.

The book is written primarily for the use of B.A. (Hons.) and B.Sc. (Subs.) students of the Bombay University. The book is divided into eleven chapters; each chapter begins with a short summary of the main topics of the section and ends with a list of questions that have appeared on these topics at the Bombay University examinations. Throughout the author's ambition has been to coach up the student for the examination and in fact this book can be said to be his lecture notes in print.

In the opinion of the reviewer the value of the book can be considerably enhanced by drawing the attention of the author to the following points:—

(1) The printing is far from satisfactory. In several places (pp. 18, 19, etc.), 'degree' mark appears on serial numbers as though they represent temperature. The figures must be numbered and their neatness improved.

(2) It is highly desirable that standard symbols for absolute temperature, etc. (p. 27), should be employed to avoid confusion.

(3) A detailed account of certain elementary portions like Dalton's atomic theory, laws of chemical combination, Avogadro's hypothesis, vapour density determination, etc., may be omitted.

(4) Greater details about electro-chemistry —ppn. of conductivity water, transport numbers, etc.,—would be very necessary as these portions will be learnt by the student for the first time.

(5) If the cost of the book is reduced further, greater section of the student population can reap the benefit of the labours of the author.

M. R. A.

SCIENCE NOTES AND NEWS

Inaugurating the first Joint Session of the Indian Academy of Sciences, and the National Academy of Sciences, India, held in Hyderabad (Deccan), H. H. the Prince of Berar said: "Your efforts in the field of science will, I feel sure, help India to join in overcoming the forces of aggression and in marching with steady step towards peace and prosperity. You have done much to give India a prominent place in the scientific world and I am sure you will meet with further success in solving the mysteries of Nature and in using her gifts for the progress of mankind."

Welcoming the Fellows and delegates of the Joint Session of the Indian Academy of Sciences and the National Academy of Sciences, India, held in Hyderabad, Md. Abdur Rahman Khan, President of the Hyderabad Academy, said:—

"In these days of ultra-specialisation it is impossible for any one man to appreciate fully the deliberations of the various sections in which the activities of the Science Academies here assembled will be conducted. Allow me, however, to point out that, through your brilliant researches and epoch-making discoveries you have given India the foremost place in the demain of Academic activity in Asia. To Sir C. V. Raman, in particular, to Sir P. C. Ray, Professors Saha, Birbal Sahni, Bhatnagar, Krishnan and Bhabha and a host of others, we are indebted for placing India in the forefront of international renown. We are looking forward to your contributions in post-war reconstruction schemes to such important branches of Applied Science as aeronautics, navigation, military and marine engineering, industrial and biochemistry, etc., which will make India a self-contained and self-supporting unit in the galaxy of progressing nations.

"Civiliaztion owes a tremendous debt to the early astronomers of Egypt, Babylonia, Assyria and China; to the savants of ancient Greece (mostly through the institution of Plato's Academy in the modest grove of Academus in Athens, hence the name Academy which we are all proud to adopt), to the all-round contributions of Arab intellect and to Hindu mathematics and medicine.

"Our present experience has brought home to us all too plainly the inadequacy of purely scientific investigations, unleavened or modified by philosophical contemplation and philanthropic conceptions, treating the whole human race as a single entity, undifferentiated by artificial distinctions of caste, colour, creed or nationality. India, the land of Gautama Buddha and Amir-Khusrau, may yet be able to bring the world back to Peace and Plenty, Co-operation, Contentment and Universal Happiness, through the practice and preaching of its God-fearing and man-loving philosophers. Let us pray that this goal is not far off and we shall soon witness its blessings spread all over the globe, as was done on more than one occasion in the past.

"Coming down to more local matters, I have a more mundane, and to a large extent, personal message to offer. Having retired from Government service, I was abruptly cut off from the experimental world; but human mind easily adapts itself to environment. I found ample scope for incessant work in the pursuit of observational astronomy, like the determination of meteor radiants, the significance of moon-lit meteors and the drift of long-enduring trains, disclosing the presence of strong convection currents in the upper atmosphere; and the equally interesting study of Variable Star phenomena. To calculate the heights and orbits of exceptionally bright meteors and make a systematic study of their spectra, a number of keen observers provided with suitable apparatus and scattered over different parts of the country, are needed. Harvard and Yale, the British Astronomical Association, the Flower Astronomical Observatory of Pennsylvania, the University of Toronto, Canada and the Sternberg Astronomical Institute of Moscow (to name only a few) are devoting more and more attention to these fascinating topics and publishing the results of their observation and research. May I take this opportunity to invite some of you gentlemen, with more leisure at your disposal, to participate in this movement and fill up the gap in our programme of scientific investigations?"

In the course of his welcome address to the delegates of the Thirty-first Session of the Indian Science Congress held at Delhi, Sir Maurice Gwyer said:

"Indian science has already achieved a position second to none in the world, and Indian men of science have it in their power to make a contribution to the future welfare of India almost beyond human computation. They can transform the face of India, they can multiply its wealth, they can solve the problems of ignorance and poverty; and who knows whether they may not even be able to solve the most intractable of all, India's constitutional problems? It is the earnest prayer of all who have the happiness and welfare of this country at heart that all these problems, surveyed in the calm and serene atmosphere of science by men consecrated to the search for truth and nothing but the truth, with minds free from prejudice or bias, may find a solution, or at least the beginnings of a solution, at the meetings this week in Delhi.

By the irony of circumstance, war, that great enemy of human progress, affords the most powerful stimulus to scientific research that we know; but good can come out of evil, as war is followed by peace; and that part of the world which still loves peace and still believes in human personality in the dignity of man and in honest dealing between nation and nation, will benefit hereafter from the labours of scientists to put new and ever more potent weapons in its hands to defeat the enemies of mankind. For those and for the many other

blessings which, by the goodness and mercy of God, men of science have bestowed upon us, we tender them our gratitude; and we hope that their labours this week and the discussions and contacts which a gathering like this makes possible will bear fruit a hundredfold.

In the course of his Presidential Address to the twenty-sixth session of the Indian Economic Conference held in Madras, Dr. B. V. Narayanaswamy Naidu said: "Hitherto the material resources of India have been mobilised for winning the war. The time has now come for us to realise that as so soon as the war is over, this mobilisation cannot be dropped but has to be reoriented for winning the greater victories of peace. It is up to us to realise, that we have to see to it that the war controls are carried on into peace-time and utilised by capable and sympathetic hands for the promotion of India's wealth and welfare. The aim should be steadily kept in view to bring about a maximum utilisation of the material and human resources of the vast sub-continent of India in the interests of all its inhabitants. Such a plan will lead to the providing for all Indians the minimum of necessaries like food, clothing, housing, medical help and education."

In any scheme of social welfare, provision for cheap, abundant and nourishing food should take the place of honour. Taking as basis a family of three adults and two children, the minimum annual food requirement for this unit would be Rs. 240, if we are to take Dr. Aykroyd's standard, while other essentials like fuel would demand an additional Rs. 120. According to this computation, every individual with a family requires Rs. 30 per mensem excluding contributions for social insurance. This would involve a provision for a total income of at least Rs. 3,000 crores a year. At the same time, it must be borne in mind that this is only the minimum; the average is bound to be higher and therefore in order to ensure the minimum to all, the national income will have to be many times this figure.

No effort should be considered too arduous, no expense too heavy for carrying into execution a comprehensive plan which will include both agriculture and industry. Whenever in the past a plea was made for nation-building activities, an old horse, named lack of capital, was trotted out by obscurantists. Where there is a will to bring about a new order in India, the way can surely be devised. If there is to be an easy transition from a war economy to a peace economy, if India's millions are not to be for ever starving, ignorant and suffering, a co-ordinated plan for industrial and agricultural development, is a prime need."

"Any planned scheme of economic development for India", proceeded Dr. Naidu, "must not be a slavish imitation of Western industry with its urban civilisation and perpetual clash of classes. Industry at the present day has reached a stage when it is dependent for its very existence and survival on the sympathy, encouragement and active support of the State. When a State like India wants to promote new industrial ventures, it can itself undertake the organisation, and see that it is worked in the interests of all the people. Even if new enterprises are entrusted to individual or corporate management, the State should insist that the benefits thereof flow equally to the whole community and are not utilised to promote the profits and interests of a few. In other words, the planned economy of post-war India must be so conceived and designed that surely and inevitably it will lead ultimately to a socialistic new order in India."

At the twenty-fourth session of the All-India Liberal Federation held in Bombay, the Federation adopted a resolution on post-war reconstruction. The resolution, referring to the Committees appointed by the Government of India and certain Provincial Governments for the purpose, emphasised that the main functions of such Committees would be to lay the foundations of a well-planned economy which would increase the cultivation of productive crops, improve agricultural methods, expand rural reconstruction and liquidate illiteracy. Among other essential requirements, the resolution continued, are the improvement and extension of communications and works of irrigation, the creation of an Indian mercantile marine, increased medical aid, the establishment of better health conditions, the provision of social services such as insurance against sickness and unemployment, and a general improvement in the standard of living.

The resolution further urged the Government to have a settled policy to assist in the establishment of new industries and in the development of the natural resources of the country; and pointed out the necessity, after the war, of the protection of nascent industries against foreign competition.

For the first time in its annals, a meeting of the Royal Society was held outside England, when Prof. A. V. Hill, on behalf of the President of Royal Society, admitted Dr. S. S. Bhatnagar and Prof. H. J. Bhabha to the fellowship of the Society.

As these distinguished scientists could not go to England on account of the war, the Royal Society empowered Prof. Hill to admit them by holding an extraordinary meeting attended by the delegates to the Indian Science Congress. Prof. Hill on that occasion stated:

"This occasion is unique in the fact that, for the first time in its 281 years, the Royal Society is holding a meeting outside England."

Sir C. V. Raman has been re-elected President of the Indian Academy of Sciences for the period 1943-46 at the ninth annual session of the Academy held at Hyderabad. Dr. H. J. Bhabha, Dr. K. R. Ramanathan, Prof. Birbal Sahni and Lt.-Col. S. S. Sokhey were re-elected Vice-Presidents.

The following have been elected Fellows of the Indian Academy of Sciences at the Ninth Annual Meeting held at Hyderabad:—Major Inderjit Singh, PH.D. (Cantab.), I.M.S., Officer-in-Charge, Brigade Laboratory, *Allahabad*. Dr. R. S. Krishnan, M.A., D.SC., Physics Department, Indian Institute of Science, *Bangalore*. Prof. G. P. Majumdar, M.SC., PH.D., Professor of Botany, Presidency College, and Lecturer, Calcutta University, 19, Ekdalia Place, Ballygunj, *Calcutta*. Dr. G. V. L. N. Murty, D.SC., Research

Chemist, Tata Iron and Steel Works, *Jamshedpur*. Prof. L. Narayan Rao, M.Sc., Ph.D. (Lond.), Professor of Botany, Central College, *Bangalore*. Dr. V. Ramaswami, B.A. (Cantab.), Ph.D. (Cantab.), Head of the Department of Mathematics, Andhra University, *Guntur*. Dr. K. L. Ramaswamy, D.Sc., Superintendent of Works, Mysore Chemicals and Fertilisers, Ltd., *Belgola*. Prof. K. P. Rode, M.Sc., Ph.D., Head of the Department of Geology, Andhra University, *Guntur*. Dr. U. Sivaraman Nair, M.A., Ph.D., Assistant Professor of Mathematics, University College, Trivandrum. Prof. K. Sreenivasan, B.Sc., A.I.I.Sc., M.I.E.E., Mem.I.R.E., Mem.A.I.E.E., Head of the Department of Electrical Technology, Indian Institute of Science, *Bangalore*. Prof. C. S. Venkateswaran, M.A., D.Sc., F.Inst.P., Professor of Physics, University of Travancore, *Trivandrum*.

Lady Tata Memorial Trust: Research Scholarships for 1944-45.—(1) Applications are invited for six Scientific Research Scholarships of the value of Rs. 150 per month each for the year 1944-45.

(2) The Scholarships are open to men and women, and will be tenable for a period of twelve months commencing from the 1st July 1944. Any or all the Scholarships may be extended for a further period of twelve months, within the discretion of the Trustees. All old scholars who desire renewal should re-apply.

(3) Applicants, who must be of Indian nationality, must be Graduates in Medicine or Science of a recognised University. They must undertake to work whole-time and will be debarred from private practice. In the duration of the period of his scholarship or award the recipient of the benefit shall devote himself to the work before him to the entire satisfaction of the Trustees, who reserve the right to withhold payment on the recommendation of the Advisory Committee.

(4) The subject of scientific investigation which they may select must have a bearing directly or indirectly on the alleviation of human suffering from disease.

(5) Applications must be forwarded through the Director of a recognised Research Institute or Laboratory where the candidate proposes to work and must be accompanied by a letter from the Director stating that he has critically examined the details of the proposed Research, that he approves of the general plan and that he is willing, as far as possible, to guide and direct the investigation and give laboratory facilities.

(6) Candidates will be required to furnish the following additional information in their application, along with certificates of physical fitness and character: (*a*) Full Name, (*b*) Age, (*c*) Sex, (*d*) Permanent Address, (*e*) Details of Academic Career, (*f*) Particulars of their past and present Research qualifications, (*g*) Particulars of the proposed Research, and (*h*) *What other emoluments, scholarships and pay or any other financial support from friends or relations they are or will be in receipt of during the period they are Scholars and the amount if any*.

(7) Applicants must give (*a*) a short resumé on the subject indicating present state of knowledge and (*b*) details of the proposed research indicating (*i*) the methods intended to be employed, (*ii*) previous experience in the use of these methods and (*iii*) the experiments to be carried out.

(8) Applications, which must be typed, must give full particulars in the order indicated above and must be addressed to the *Secretary, The Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay*, so as to reach him not later than 15th March 1944.

(9) Applicants are warned that any canvassing, direct or indirect, of the Trustees or Members of the Selection Committee, will entail disqualification, and also that the Scholarships are liable to be terminated without any notice on receipt of any unfavourable report from the Director under whom a Scholar may be working.

(10) The result of the selection will be announced on the 18th June 1944 and the successful candidates will be required to report themselves for duty, to their respective Directors, on the 1st July 1944.

(11) Scholars will be required to submit periodical progress reports every six months to the Secretary of the Trust, through the Directors and with their remarks of the work done.

Indian Mathematical Society: The Narasinga Rao Medal for Mathematical Research.—The Indian Mathematical Society has instituted a medal for the encouragement of mathematical research endowed by Dr. A. Narasinga Rao of the Annamalai University. The medal will be awarded to the best solution or contribution towards the solution of a specified problem in mathematics. A period of at least eighteen months will be given for the submission of theses dealing with the problem and the award will be made at the Conference of the Indian Mathematical Society which meets immediately after its adjudication. To be eligible to compete for the medal, the competitor must be of Indian domicile and must be a member of the Indian Mathematical Society at the time of submitting the thesis and at the time of award. There is no entrance fee.

One of the objects of the award is to direct the attention of younger researchers in India to modern topics in mathematics which have not so far received their due share of attention.

Particulars regarding the first prize problem under the above endowment which was selected by a special committee at the Annamalainagar Mathematical Conference, can be had from the Secretary.

Theses connected with the problem should be sent to Dr. A. Narasinga Rao so as to reach him before the end of July 1945.

The Syndicate of the University of Utkal has accepted a sum of Rs. 7,000 donated by the Public Utility and Charitable Fund of the district, towards the establishment of a university library.

A Possible Reprinting of Saccardo's *Sylloge Fungorum*.—The Alien Property Custodian has recently announced (*Science*, 1943, 97, 303-4) that many technical books and sets of books of Axis origin are available for republication. The procedure to be followed in obtaining necessary licences and other details is given

and it is clear that every encouragement will be given to bring about prompt reproduction of books of this kind.

To mycologists and plant pathologists this announcement immediately suggests the possibility of the reproduction of Saccardo's classical *Sylloge Fungorum* in usable form. This compendium of mycological descriptions is a *sine qua non,* and the comparatively few sets now in use in the Americas are showing the effect of much use. Additional copies have been practically non-existent heretofore, only occasional sets appearing on the market at rare intervals and at exorbitant prices. There are undoubtedly many institutions as well as individual mycologists and plant pathologists who will welcome an opportunity to purchase a set of Saccardo. Even those libraries now possessing the work will likely desire an additional set to relieve the wear and tear on the original.

It has been ascertained that a satisfactory reproduction of the 25 volumes can be produced. If 100 subscriptions are obtained by September 1, the complete set of 25 volumes can be obtained at $200.00 per set; if 300 subscriptions are obtained, the price will be $150.00 per set. These prices are based on an offset edition, with the type block photographically reduced ten per cent.

In order that the undersigned may obtain an idea of the number of prospective purchasers, interested mycologists are requested to send in tentative subscriptions and to interest their respective institutions in doing likewise.

Bureau of Plant Industry
Station, Beltsville, JOHN A. STEVENSON.
Maryland.

It is understood that the Government of India will soon constitute an industrial commission consisting of about ten prominent industrialists who will undertake an extensive tour of the United Kingdom and the United States of America in order to study the development of industries and discuss ways and means by which their war-time industries will be changed to fit the peace-time economy during the post-war period.

The Government of India have appointed a committee, under the chairmanship of Mr. D. V. Rege, I.C.S., to report upon a "Beveridge Plan" for industrial workers during the post-war period.

A complete assembly for the manufacture of sugar on a cottage industry scale, has been designed and constructed at the Sugar Research and Testing Station, Bilari. The plant can be operated by the grower with the aid of his family and his bullocks. Besides yielding a higher return for the labour involved, the sugar manufactured with this plant is free from excise duty as no motive power is employed.

The Government of Mysore have decided to organise the Sericulture Industry in the State on a more stable basis. In this, they are to take advantage of the prevailing absence of competition from China and Japan and the consequent rise in the price of silk, for the benefit of the industry. The Silk Control Order which has been recently promulgated seeks to further the war effort and secure the permanent advance of the industry. A third of the net profits realised by the sale of silk in the State is earmarked for researches directed towards the consolidation and expansion of the industry.

Benares Hindu University.—Mr. C. Dakshinamurti has been awarded the D.Sc. of the Benares Hindu University, in Physics, at the Convocation held on the 28th November 1943 for his thesis "Doppler Effect in Positive Rays of Hydrogen, etc."

MAGNETIC NOTES

Magnetic conditions during December 1943 were slightly less disturbed than in the previous month. There were 11 *quiet* days, 19 days of *slight* disturbance and 1 day of *moderate* disturbance as against 16 quiet days, 13 days of slight disturbance and 2 days of moderate disturbance during the same month last year.

The quietest day during December 1943 was the 6th and the day of the largest disturbance the 16th.

The individual days during the month were classified as shown below.

Quiet days	Disturbed days	
	Slight	Moderate
6–8, 11–13, 15, 24, 27, 28, 30.	1–5, 9, 10, 14, 17–23, 25, 26, 29, 31.	16

No magnetic storms occurred during the month of December in the years 1942 and 1943.

The mean character figure for the month of December 1943 was 0·68 as against 0·55 for December 1942.

M. V. SIVARAMAKRISHNAN.

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 91, Nos. 4651, 4652.

"Annals of Biochemistry and Experimental Medicine," Vol. 3, No. 2, 1943.

"Calcutta Review," Vol. 89, No. 2; and Vol. 90, No. 1.

"Journal of the Indian Chemical Society," Vol. 20, No. 10.

"Chemical Products and Chemical News," Vol. 6, Nos. 9 to 12.

"Indian Farming," Vol. 4, No. 7.

"Transactions of the Faraday Society," Vol. 39, Pts. 9 and 10.

"Indian Forester," Vol. 70, No. 1.

"Central Board of Irrigation (Bulletin)," No. 1, Oct. 1943.

"Indian Trade Journal," Vol. 151, Nos. 1956, 1958; Vol. 152, No. 1959.

"Monthly Science News," No. 27.

SUPPLEMENT TO CURRENT SCIENCE

Vol. XIII] INDIAN SCIENCE CONGRESS, DELHI, 1944 [No. 1

Summaries of Addresses of the Congress President and Presidents of Sections

PRESIDENTIAL ADDRESS

Congress President: PROFESSOR S. N. BOSE

THE CLASSICAL DETERMINISM AND THE QUANTUM THEORY

I WOULD like to present before you certain aspects of modern physics and draw your attention to the profound changes in the principle of scientific explanation of natural phenomena brought about by the quantum theory. The last fifty years record remarkable discoveries. These discoveries have their repercussions in the realm of ideas. Fifty years ago the belief in causality and determination was absolute. To-day physicists have gained knowledge but lost their faith. To understand properly the significance of such a profound change it will be necessary to discuss briefly how it all came about. Classical physics had begun with the study of astronomy. Physicists had taken the equations of celestial mechanics as their model of a universal law. Since matter had resolved into a conglomeration of particles, the ideal scheme was to explain all phenomena in terms of their motions and interactions. It was only necessary to set up a proper set of equations, and to take account of all possible mutual interactions. If the mass, position, and velocity of all the particles were known at any instant, these equations would theoretically enable the physicist to predict the position and motion of every particle at any other subsequent moment.

The phenomena of light did not at first fit into this simple scheme. With the discovery of the electron as a universal constituent of matter, the electromagnetic theory of Maxwell was converted into an electronic theory by Lorentz. To the dynamical laws were added the electromagnetic equations and the two together apparently gave an exact and ideal formulation of the laws of causality. It was more or less a matter of faith to maintain that if it were possible for us to obtain all the necessary data by delicate observations, universal laws would enable us to follow each individual molecule in this intricate labyrinth and we should find in each case an exact fulfilment of the laws and agreement with observation. The above in brief forms an expression of faith of a classical physicist. We see that it involves as necessary consequences, belief in continuity, in the possibility of space-time description of all changes and in the existence of universal laws independent of observers which inexorably determine the course of future events and the fate of the material world for all times.

II

The development of the quantum theory has raised fundamental issues. Facts have been discovered which demonstrate the breakdown of the fundamental equations which justified our belief in determinism. A critical examination of the way in which physical measurements are made has shown the impossibility of measuring accurately all the quantities necessary for a space-time description of the motion of the corpuscles.

Experiments reveal either the corpuscular or the wave nature for the photon or the electron according to the circumstances of the case, and present us with an apparently impossible task of fusing two contradictory characters into one sensible image. The only solution suggested has been a renunciation of space-time representation of atomic phenomena and with it our belief in causality and determinism.

Let me briefly recapitulate the facts. In 1900 Planck discovered the quantum of action while studying the conditions of equilibrium between matter and the radiation field. Apparently interchange of energy took place in discrete units whose magnitude depended on h and the frequency of the radiation emitted or absorbed by matter. Photo-electric emission had similar disquieting features. Einstein, therefore, suggested a discrete structure of the radiation field in which energy existed in quanta instead of being continuously distributed in space as required by the wave-theory. This light-quantum, however, is not the old light-corpuscle of Newton. The rich experimental materials supporting the wave-theory preclude that possibility altogether. Moreover the fundamental relation, $E = h\nu$, and $p = hk$, connecting energy and momentum of the photon with the frequency ν and the vector wave number k, makes a direct reference to idealised plane wave so foreign to the old idea of a corpuscle. Soon afterwards Böhr postulated the existence of radiationless stationary states of atoms and showed how it led to a simple explanation of the atomic spectra. The extreme simplicity of the proposed structure and its striking success in correlating a multitude of experimental facts at once revealed the inadequacy of the ordinary laws of mechanics and electro-dynamics in explaining the remarkable stability of the atoms.

The new ideas found application in different branches of physics. Discontinuous quantum processes furnished solutions to many puzzles. Suitably modified, the theory furnished a reasonable explanation of the periodic classification of elements and thermal behaviour of substances at low temperature. There was, however, one striking feature. It was apparently

impossible to characterise the details of the actual transition processes from one stationary state to another, that is, to visualise it as a continuous sequence of changes determined by any law as yet undiscovered. It became clear that the dynamical laws as well as the laws of electromagnetism failed to account for atomic processes. New laws had to be sought out compatible with the quantum theory capable at the same time of explaining the rich experimental materials of classical physics. Böhr and his pupils utilised for a time a correspondence principle, guessing correct laws for atomic processes from analogy with the results of the classical theory. In every case these appeared as statistical laws concerned with the probabilities of transition between the various atomic states. Einstein tackled the problem of the equilibrium of matter and radiation on the basis of certain hypotheses regarding the probabilities of transition between the various states by absorption and emission. A derivation of the Planck Law was obtained by Bose by a suitable modification of the methods of classical statistics. Heisenberg finally arrived at a satisfactory solution and discovered his matrix-mechanics and a general method for all atomic problems. Dirac and Schrödinger also published simultaneously their independent solutions. Though clothed in apparently dissimilar mathematical symbols, the three theories gave identical results and have now come to be looked upon as different formalisms expressing the same statistical laws.

I have mentioned that the photon gave a simple explanation of many of the properties of radiation and thereby presented its corpuscular aspect while the well-known properties of interference and superposibility brought out its wave character. That the same dual nature may exist in all material corpuscles was first imagined by De Broglie. His phase-waves found quick experimental verification, and raised a similar problem of the real nature of the corpuscle. The formulation of wave-mechanics by Schrödinger, once raised a hope that by a radical modification of our usual ideas about the corpuscle it might be possible to re-establish the law of causality and classical determinism. Subsequent developments have shown such hopes to be illusory. His waves are mathematical fictions utilising the multidimensional representation of a phase-space and are just as incapable of explaining the individuality of the electron, as the photon is incapable of explaining the superposibility of the field. The true meaning of his equations appears in their statistical interpretation.

III

The adherents of the quantum theory interpret the equations in a peculiar way. They maintain that these equations make statements about the behaviour of a simple atom and nothing more than a calculation of the probabilities of transition between its different states is ever possible. There is nothing incomprehensible about such a statistical law even if it relates to the behaviour of a single particle. But a follower of determinism will interpret such statements as betraying imperfect knowledge, either of the attendant circumstances or of the elementary laws. We may record the throws when a certain die is cast a large number of times and arrive at a statistical law which will tell us how many times out of a thousand it will fall on a certain side. But if we can take into account the exact location of its centre of gravity, all the circumstances of the throw, the initial velocity, the resistance of the table and the air and every other peculiarity that may affect it, there can be no question of chance, because each time we can reckon where the die will stop and know in what position it will rest. It is the assertion of the impossibility of even conceiving such elementary determining laws for the atomic system that is disconcerting to the classical physicist.

Von Neumann has analysed the statistical interpretation of the quantum mechanical laws and claims to have demonstrated that the results of the quantum theory cannot be regarded as obtainable from exact causal laws by a process of averaging. He asserts definitely that a causal explanation of quantum mechanics is not possible without an essential modification or sacrifice of some parts of the existing theory.

Böhr has recently analysed the situation and asserted that we cannot hope any future development of the theory will ever allow a return to a description of the atomic phenomena more conformable to the ideal of causality. He points out the importance of the searching analysis of the theory of observation made by Heisenberg, whereby he has arrived at his famous principle of indeterminacy. According to it, it is never possible for us to determine the simultaneous values of momentum, and positional co-ordinates of any system with an accuracy greater than what is compatible with the inequality

$$\Delta p \, \Delta q > \frac{h}{4\pi}.$$

This natural limitation does not affect the physics of bodies of finite size but makes space-time descriptions of corpuscles and photons impossible. When we proceed to study the behaviour of the elementary particles, our instruments of measurement have an essential influence on the final results. We have also to concede that the contributions of the instrument and the object, are not separately computable from the results as they are interpreted in a classical way with the usual ideas of co-ordinate and momentum accepting thereby a lack of control of all action and reaction of object and instrument due to quantum effects.

It is in this imperative necessity of describing all our knowledge with the usual classical ideas, that Böhr seeks an explanation of the apparently irreconcilable behaviour of corpuscles and radiation in different experiments. For example, if we set our experiments in such a fashion as to determine accurately the space-time co-ordinates, the same arrangement cannot be simultaneously used to calculate the energy momentum relations accurately; when our arrangements have pushed the accuracy of determining the positional co-ordinates to its utmost limit, the results evidently will be capable only of a corpuscular representation. If, on the other hand, our aim is to determine momentum and energy with the utmost accuracy, the necessary apparatus will not allow us any determination of positional co-ordinates

and the results we obtain can be understood only in terms of the imagery of wave-motion. The apparently contradictory nature of our conclusions is to be explained by the fact, that every measurement has an individual character of its own. The quantum theory does not allow us to separate rigorously the contribution of the object and the instrument and as such the sum total of our knowledge gained in individual cases cannot be synthesised to give a consistent picture of the object of our study which enables us to predict with certainty its behaviour in any particular situation. We are thus doomed to have only statistical laws for these elementary particles and any further development is not likely to affect these general conclusions.

It is clear that a complete acceptance of all the above conclusions would mean a complete break with the ancient accepted principles of scientific explanation. Causality and the universal laws are to be thrown simultaneously overboard. These assertions are so revolutionary that, no wonder, they have forced physicists to opposing camps. There are some who look upon causality as an indispensable postulate for all scientific activities. The inability to apply it consistently because of the limitations of the present state of human knowledge would not justify a total denial of its existence. Granted that physics has outgrown the stage of a mechanistic formulation of the principle, they assert that it is now the task of the scientists to seek for a better formulation. Others of the opposing camp look upon old determinism as an inhuman conception, not only because it sets up an impossible ideal, but also as it forces man to a fatalistic attitude which regards humanity as inanimate automata in the hands on an iron law of causation. For them the new theory has humanised physics. The quantum statistical conception of determinism nestles closer to reality and substitutes a graspable truth for an inaccessible ideal. The theory has brought hope and inspired activity. It constitutes a tremendous step towards the understanding of nature. The features of the present theory may not all be familiar but use will remove the initial prejudice. We are not to impose our reason and philosophy on nature. Our philosophy and our logic evolve and adjust themselves more and more to reality.

In spite of the striking success of the new theory, its provisional character is often frankly admitted. The field theory is as yet in an unsatisfactory state. In spite of strong optimism, difficulties do not gradually dissolve and disappear. They are relegated to a lumber room, whence the menace of an ultimate divergence of all solutions neutralises much of the convincing force of imposing mathematical symbols. Nor is the problem of matter and radiation solved by the theory of complementary characters. Also we hear already of the limitations of the new theory encountered in its application to nuclear problems.

The quantum theory is frankly utilitarian in its outlook; but is the ideal of a universal theory completely overthrown by the penetrating criticism of the nature of physical measurements?

Böhr has stressed the unique character of all physical measurements. We try to synthesise their results and we get probabilities to reckon with instead of certainties. But how does the formalism $\frac{h}{2\pi i}\frac{\partial\psi}{\partial t} = H\psi$ emerge as a certain law? The wider the generalisation, the less becomes the content. A universal law would be totally devoid of it. It may nevertheless unfold unsuspected harmonies in the realm of concept. More than ever now, physics does need such a generalisation to bring order in its domain of ideas.

M. A. G.

CHEMISTRY

President: DR. R. C. RAY, D.SC., F.I.C.

SOME ASPECTS OF MODERN INORGANIC CHEMISTRY

THERE are many who think that there is no future for inorganic chemistry, except in its application to industry. It is generally assumed that inorganic chemistry has progressed as far as it could with the tools at hand. The discovery of the inert gases of the atmosphere by Ramsay and his co-workers and practically all the missing elements seems to have added the last chapter to inorganic chemistry; and one may really wonder what is there left to be done. The accumulated treasures, no doubt, seem marvellous, but as each year rolls by we find ourselves, like Balboa, looking down from the mountain top, beholding an infinite and beautiful expanse, yet unfathomed. The vista continues to widen, and new problems, new theories, new view-points loom large before us.

The possibility of compound formation by the inert gas was first suggested by Villiard, who found that crystalline hydrates were formed when the inert gases admixed with water, were cooled under pressure. The structure of these hexahydrates would seem to be similar to that of the co-ordination compounds of the cobaltamine type. The recent work of Nikitin in U.S.S.R., have established the formation of $Rn.2C_6H_5OH$ and $Xe.2C_6H_5OH$ corresponding to $H_2S.2C_6H_5OH$ or $HCl.2C_6H_5OH$. Booth and Wilson have also obtained and studied the formation of $A.6BF_3$. The formation of these co-ordination compounds of inert gases opens up an interesting field of research, and a considerable amount of work still remains to be done in this direction. The formation of such compounds by the higher atomic weight inert gases is permitted also by theoretical considerations, which indicate besides that the other lighter inert gases may also form compounds after excitation. Thus while Helium does not form co-ordination compounds of the type mentioned, it is apparently capable of combining with mercury in presence of electric glow discharge at low pressures. The formation of several other helides such as WHe_2, etc., by the reaction of excited He atoms, has also been reported.

During the last thirty years, considerable progress has been made in the chemistry of Boron and its compounds, but a large amount of work still remains to be done, before adequate answers could be found for many questions which remain unanswered. The study of hydroborons and borohydrates has raised new

problems about the nature of the chemical bond. Six hydrides of Boron are now known and the recent work of Schlesinger and his school have advanced our knowledge about these highly unstable and greatly reactive substances. Two of these very interesting types of compound are borine carbonyl and the metalloborohydrides. The former is somewhat similar to volatile metal carbonyls. The metallic borohydrides are generally prepared by the action of diborane on the alkyl compounds of the corresponding metals. Lithium borohydride is a definitely salt-like substance and has been given the formula $Li^+ BH^-_4$, but the beryllium borohydride BeB_2H_8 is a highly volatile solid, and aluminium borohydride $Al.B_3H_{12}$ is a still more volatile liquid. The gradation of properties from the relatively high melting non-volatile and polar lithium borohydride to the low-melting, highly volatile and almost non-polar aluminium borohydride is very striking; while the properties of aluminium borohydride approach those of diborane itself, the properties of beryllium borohydride are intermediate between those of corresponding lithium and aluminium compounds.

The mechanism of hydrolysis of magnesium boride has been studied by Ray and co-workers with interesting results. Contrary to what has been generally supposed, no boric acid or magnesium borate is formed in the hydrolysis of magnesium boride by water or dilute acids, but $H_3B_2(Mg.OH)_3$ and $Mg_3B_2(OH)_2$. The aqueous extract is a strongly reducing solution containing $H_6B_2O_2$. This compound exists in 2 isomeric forms α and β, the most important difference between these being that while a molecule of the α-compound loses 4 atoms of hydrogen when treated with an acid, the β-compound yields only 2 atoms of hydrogen per molecule. The constitution of these isomeric borohydrates provides a very interesting study on the nature of chemical bonds, particularly considering that it is now generally admitted that any chemical bond is not the resultant of a pair of electrons nor even of all the electrons associated with the pair of bonded atoms, but of all the electronic forces in the molecule. It seems that the solution of the mystery of the nature of the chemical bond lies hidden in the chemistry of the inert gases and that of boron.

While the constitution and structure of most organic compounds have been worked out, analytically as well as synthetically, the same thing cannot be said about many inorganic compounds. For instance our knowledge about the metallic hydrides is still incomplete. It is well known that some rare-earth metals, zirconium, tantalum and titanium, form a class of hydrogen compounds in which there does not exist an exact stoichiometric relationship between the metal and the hydrogen atoms, and these are generally regarded as interstitial compounds. Some of these "hydrides", however, possess high values for their heats of formation, suggesting that there can be little difference in the nature of the chemical bond in a substance such as zirconium hydride, $ZrH_{1 \cdot 98}$ (heat of formation = 38,900 cals.) and barium hydride, BaH_2 (heat of formation = 40,960 cals.). It is one of the puzzling features of this group of substances.

The list of topics can, of course, be made much larger and may well include fields of other investigations in which both experimental methods and relevant theories are still lacking. It is clear, however, from what has already been said, that there has probably never been a time when the prospects of inorganic chemistry were so promising as they are to-day. M. A. G.

BOTANY

President: Dr. T. S. Sabnis

PROGRESS OF BOTANY WITH SPECIAL REFERENCE TO ECONOMIC PLANTS

THE science of plant breeding and genetics has played a dominant role in the creation of better crops. Mendel's laws of heredity gave impetus all over the world to apply them for the benefit of evolving varieties with desirable traits. The present-day sugar-beet with its trebled sugar content, Marquis wheat, Yeomen I and Yeomen II and Howard's Pusa varieties of wheat which are the best yielding strains, are the outcome of intensive work on breeding. Cytology has recently come to play an important part in plant breeding; desirable gene combinations have been made possible by a cytological study of the different varieties of plants and this study has helped further to induce fertility in sterile hybrids which is a source of setback in plant breeding. The potentiality of inducing polyploidy does not merely end in inducing fertility but a further application of this phenomenon has resulted in plants like tomato and maize with increased nutritive content.

The discovery of ecotypes or biotypes in a species has provided a larger arena for the breeder. It has been possible to evolve newer and better-yielding forms by a close study of the variations in the ecotypes and has a great application both for improving agricultural and forestry plants. The findings of Clements and his co-workers regarding the growth of plants in relation to their environmental factors, that qualitatively water is the most important and that quantitatively light and nutrients, is of immense help particularly in the improvement of grasslands and forage crops.

Photoperiodism and vernalization have given wonderful results particularly in the U.S.A. and Russia. The finding that the general effect of shortened illumination resulted in an earlier production of flowers, has become a boon to synchronising the flowering period of widely divergent varieties. This has a very important possibility of cross-fertilising them under normal conditions. Such a result has already been achieved by crossing Egyptian cotton with low boll with several South American cottons with large bolls but of short day and perennial habit. 'Light' treatment is finding use in India in the improvement of potato. Lysenko subjected certain seeds to various temperature treatments and found that the vegetative stage was greatly reduced and the flowering stage commenced very early. This finding has resulted in many varieties of winter wheats yielding good crop, which without vernalization would not ear when sown in spring.

Economy in time and energy of raising fresh

plants has been made possible by the application of growth hormones. Contributions from the Boyce Thompson Institute and the investigations of Zimmermann and Hithhcock have opened up the possibility of employing the application of growth hormones on a commercial scale particularly for the rooting of cuttings which prove difficult and seedlings which are too delicate and suffer considerable mortality in early stages. It is of particular interest to note that when seeds are treated with the hormones obtained from Rhizopus and Yeast, the reproductive phase of such plants commenced earlier, much in the same manner in the case of vernalized seeds.

The role of secondary elements like boron, manganese, etc., is shown to be of vital importance for successful growth and fructification. And this has helped to combat certain deficiency diseases also. Soil-less culture is finding popularity but its success depends upon much spadework which is still to be done. Breeding has again played a major part in evolving varieties resistant to certain diseases. Particularly in America and Canada great success has been achieved in breeding rust and smut-resistant individuals from existing varieties. B. G. L. S.

ZOOLOGY AND ENTOMOLOGY

President: DR. VISHWA NATH

THE GOLGI APPARATUS

IN his Presidential Address to the Section of Zoology and Entomology Dr. Vishwa Nath has given a summary of the present position of the Golgi Apparatus, incorporating some of his own views regarding the form and function of this cytoplasmic structure. A very large number of papers have appeared since 1898 when first this apparatus was discovered by Golgi and to-day, we are able, to a certain extent, to marshal the great array of facts and observations that have accumulated about the form, composition and function of this body. It is now known that the Golgi apparatus is found in every type of animal cell (and in most plant cells) and instead of being artefacts as they were once believed to be, they are real and living bodies in the cell. But their form, however, is subject to great variation, depending, mostly, on the technique employed; and here, Dr. Nath holds the belief very fixedly and vehemently that they are spherical granules and never of any other form. All other forms,—networks, dictyosomes, batonettes and rods are, according to him, artefacts, a conclusion which he has arrived at from an examination of a variety of cells. In chemical composition, the Golgi bodies are fats linked with proteins. The protein probably occupies the outermost layer of the Golgi sphere. In comparison with mitochondria the Golgi bodies have relatively less protein than lipoids and also their specific gravity is less than that of mitochondria as shown by experiments with the centrifuge.

The function of the Golgi bodies is also manifold. They give rise to the acrosome in sperm formation, to fat in oogenesis and to secretory granules in gland cells. But the exact method of formation of these bodies is a subject of controversy. Dr. Nath holds the view that in all the three cases a direct transformation of the Golgi apparatus into the products takes place, while the majority of workers are of opinion that they are products of secretion of the Golgi apparatus. There appears to be a close relation between the Golgi bodies and the mitochondria as the recent work of Hirsch has shown and it is possible that the Golgi pre-substance which is the primordial Golgi material in the cell is the contribution by the mitochondria and probably also the nucleus and cytoplasm.

There really does not seem to be much use in debating at great length and with much heat the problem of the exact form of the Golgi apparatus or the precise manner in which the products are formed by it. Would it not be better to realise that this "most protean of all cytoplasmic inclusions" is, like the living protoplasm of which it forms part, capable of varied manifestations, expressing itself in a hundred forms, all different but all designed to the same end, of fulfilling their destiny? B. R. S.

MEDICAL AND VETERINARY RESEARCH

President:

DR. K. V. KRISHNAN, M.R.C.P., D.B., D.SC., F.N.I.

MEDICAL EDUCATION

IN his Presidential Address, Dr. Krishnan has laid stress on the great and urgent need for the proper training of the skilled medical men, a fundamental and vital question of the country. In spite of the progress and achievement of the last hundred years, he remarks, there is ample scope for further improvement and expansion in several directions. On the standard of the medical education reached in any country, Dr. Krishnan says, largely depends the soundness of medical men, the efficiency of medical service provided by the Government and its usefulness to the community.

In India we have a dual standard of medical education—lower and higher. The lower standard had to be instituted chiefly for economic reasons and as an interim expediency in the evolution of medical education. But it is now felt in India that the lower standard of education should be abolished and Dr. Krishnan hoped in very near future India would have only medical colleges and no schools.

The number of medical institutions and the number of medical men produced from such institutions have a direct bearing on the needs of medical education of a country. Dealing with this question Dr. Krishnan pointed out that the standard aimed at in Western countries was to have at least one qualified doctor for every 1,000 of the population. India falls much below this standard and while she should have at least 400,000 doctors, ten times the present number, she is having only about 1,700 new doctors every year, produced jointly by the ten medical colleges and 27 medical schools in existence. Dr. Krishnan stresses that unless some practical plan is put forward to hasten production, it will take years before India can hope to solve this question of inadequacy.

Side by side there is the problem of rural needs, which, it must be admitted, are not being

satisfied at all at present. India is predominantly a rural country; 95 per cent. of her vast population live in rural areas. The majority of these receive little or no medical aid. Although many attempts have been made to provide in the past, medical aid to rural areas, with the help of men we have been producing in our colleges, no great success has been achieved so far. This is mainly due to the fact that right type of men do not come forward to serve and also appropriate training is lacking. Dr. Krishnan suggests that it is the duty of our medical colleges to select the right type of men and train them suitably.

The importance of women doctors is also emphasised. The total number of women doctors in this country is quite small and utterly inadequate. India, with her medical problems so closely intermingled with her social problem, has a greater need for women doctors than even Russia has (where there is the largest proportion of women doctors, almost 50 per cent.). The medical colleges should throw open their doors freely to women, and offer scholarships in sufficient numbers to attract the right type.

Making suggestions for the improvement of medical education in this country, Dr. Krishnan divides medical training into two parts—under-graduate and post-graduate. Advancement of science can only be achieved through men with a scientific bent of mind. It is the responsibility of the medical colleges to produce such men through inclusion of research programme in education. In India most medical colleges have only limited resources for prosecuting research. Dr. Krishnan suggests that in quantity and quality their research activity need to be much augmented. He also lays emphasis on the importance of providing adequate clinical facilities for teaching purposes. It should be made compulsory for the students and the staff to spend more time at the bed-side than in the lecture room or laboratory as at present. Certain reforms should immediately be introduced relating to the instructional staff of the Indian medical colleges in the interest of medical education. Serious damage had been done through allowing private practice to the paid teaching staff of medical colleges. This system should at once be stopped and the constitution of a separate cadre for teaching staff be introduced immediately.

Dealing with the post-graduate courses of study Dr. Krishnan lays stress that there should be training of specialists in one or other differentiated fields of medicine and that there should be refresher courses to the general practitioner and others to keep them abreast of recent advances in their field. For the advanced type of post-graduate training, separate post-graduate institutions are generally established which will serve the purpose of teaching, advice and research. The staff should be composed of men of superior calibre whose main duties should be to give advice on all important scientific matters and to undertake research on problems of national importance.

After discussing the various aspects of medical training, Dr. Krishnan points out that almost all the colleges in India are of the ordinary type. The modern tendency is to have wherever possible medical colleges of the University type which, in the words of Abraham Flexner, "would address itself wholeheartedly and unreservedly to the advancement of knowledge, the study of the problems from whatever source they come and the training of men all at the highest level of possible effort". A few colleges in India are struggling towards the university type, and these can be reorganised and remodelled in the near future.

After discussing the various aspects of medical education and giving tentative suggestions for development or improvement in certain directions, Dr. Krishnan remarks that whatever may happen, one thing is certain that the future of medicine in this country will largely depend upon the attitude taken by the Government, the medical profession and the public on the indigenous and other systems of medicine, on the type of medical service and on the basic premical cause of ill-health. We must make up our mind as to what to do with the Ayurvedic and Unani systems of medicine. Dr. Krishnan thinks that these indigenous systems are antiquated and empirical and any sympathy or attachment to them will retard scientific progress. The type of medical service best suited to this country has also to be decided. We must study beforehand the situation in this country thoroughly and find out the type of medical service that will readily and truly take the benefits of modern scientific medicine within the reach of every individual in the country, urban and rural. And lastly, it has to be realised that the medical problem is closely connected with the social and economic problems. Unless we stamp out the basic causes of ill-health, namely, ignorance, poverty and lethargy, we will never attain any measure of success with any of the schemes. N. N. D.

PHYSIOLOGY

President: Dr. S. N. Mathur

HARMONY AND RHYTHM IN NATURE

SOME of the fundamental factors, such as, CO_2, temperature, oxygen and alternate periods of rest and activity, which are necessary for the harmonious working of the body are dealt with in this address.

The role of CO_2 in normal activities of the organs has been discussed. CO_2 is the natural excitant to vaso-motor centre. It actively increases dilatation of the heart, which indirectly results in an increased cardiac output. A certain tension of CO_2 is essential for the entire activity of the heart. CO_2 is necessary to maintain and regulate the activity of the rhythmic respiratory centre. Besides these, it plays an important part in the regulation of pH of the blood and other fluids and "indirectly ministers for the digestive needs of the body".

The regulation of internal temperature is of greater importance than the maintenance of CO_2 balance. It is found that at higher temperatures the respiratory centre is tuned to work at lower CO_2 tension and at lower temperatures, respiration and circulation become slow and CO_2 tension is raised, a mechanism directed for regulation of temperature rather than maintenance of CO_2 tension.

At low temperatures associated with anoxia, respirations become hurried and heart beats faster, showing thereby that a constant supply of adequate amount of oxygen is even a greater

need to the body than maintenance of temperature.

Of primary necessity to life is, however, alternate periods of rest and activity. Next to oxygen comes sleep. Sleep is presided over by the cholenergic part and wakefulness by adrenergic part of the autonomic nervous system. "On this conception the vagus nerve of the heart is considered not an inhibitor but as a nerve which controls and regulates the restful component of the rhythm of the heart and restores the energy lost during contraction."

Besides this diurnal rhythm of sleep and wakefulness, the body as a whole exhibits a less obvious yearly rhythm, consisting of increased activity during spring and summer, and lessened activity during autumn and winter, and thus pulsates with the rest of nature. The yearly rhythm of the body is apparently under the guidance of the two components of the autonomic nervous system. S. H.

ENGINEERING AND METALLURGY

President: MR. J. J. GHANDI

INDUSTRIAL RESEARCH

(With Special Reference to India)

THOUGH the realisation has come that organised research, pure and applied, is an absolute necessity in the present-day economic conditions of life, our research organisation in this country is still in the stage of infancy and the fields of industrial research yet to be covered are vast and boundless. How best this organisation can be improved, developed and expanded must be uppermost in many minds. A brief review of the development of Industrial Research Organisation in India starting with the constitution by the Government of India of the Board of Scientific Advice in 1902 to the establishment of the Board of Scientific and Industrial Research in April 1940, shows how slow, inadequate and unco-ordinated are the scientific and industrial research activities in this country. A study of the history of organised research in Germany, Great Britain, United States of America and U.S.S.R. serves to indicate in great contrast our vital weaknesses in the field.

It is often urged that war has filled many gaps in India's industrial structure. The statement is misleading. The gaps filled are relatively few and, by no means, of great importance: the major gaps are still unfilled. Even Australia and Canada have been able to accomplish much more in the industrial field than India and are now several paces ahead of us.

There can be no doubt to-day that if India is to survive in the post-war world of progress and competition, in which there will be more of international co-operation and less of national tariff protection, and efficiency will be the main criterion of success, we must draw up a blue-print of what our research organisation should be after the war, and do so now. There is no time to be lost.

To my mind, national research must be planned on national lines in order to prevent clashes of sectional interests, territorial and occupational, and obviate unnecessary overlapping of work and the consequent waste of money and effort. It must be adjusted to the economic structure of the country and not be a blind repetition of some foreign model. The Government, the University and Industry, each must be assigned distinct research functions, though all three must work in close collaboration towards the same end.

To summarise my proposals: The existing Board of Scientific and Industrial Research should be retained, but its membership should include a larger number of scientists than at present, so as to cover all branches of science, and the functions of the constituent bodies of the department should be slightly re-classified to prevent overlapping. The official scientific services should be autonomous in their daily operation, but should co-operate with the above-mentioned department of research. A supreme National Academy of Sciences representing the existing scientific societies should be brought into existence to co-ordinate the work of the various scientific societies and co-operate with the Board of Scientific and Industrial Research in general scientific direction. Provision has also been made for bringing industry into contact with science, and both, into contact with Government, and some indication given of the media of publicity that can be usefully exploited. M. A. G.

PSYCHOLOGY AND EDUCATIONAL SCIENCE

President: MR. JOHN SARGENT

THE practical aspect of Educational Reconstruction was the subject of the Presidential Address of Mr. John Sargent, C.I.E., to the Section of Psychology and Educational Science of the Thirty-first Indian Science Congress held in Delhi.

After stating that "anyone who knows anything about the present state of education, to say nothing of other social services in this country will realise that the question is anything but a rhetorical one", and pointing out that in such instruments as education we see the means of raising standards to a level which will at least make government of the people by the people for the people a practical proposition, Mr. Sargent says: "An India, 85 per cent. of whose population are illiterate and liable as we have seen more than once in recent years, to be stampeded by political and religious excitement, however irrational, constitutes a field for mischief-makers, the infinite continuance of which world opinion in search of a more stable future can hardly be expected to tolerate. Is it unreasonable to anticipate that whatever may satisfy government or big business or all the other vested interests, whose vision is either oblique or retrospective, the logic of any post-war settlement will demand a drastic change in the present state of things?"

Mr. Sargent then states the minimum programme of development and essential requirements, which will place India on an approximate educational level with other countries. The scheme provides for a national system of education to provide all children in India with eight years of basic education and enable promising children to pass on to high schools, universities, technical and commercial schools

and art institutions. The following are the essential requirements in brief:—

(1) Universal compulsory and free education for all boys and girls from the age of five or six until fourteen, in order to ensure literacy and the minimum preparation for citizenship.

(2) A reasonable provision of education before the compulsory age for school attendance in the form of nursery schools and classes. This is particularly important in the interest of health in areas in which housing conditions are unsatisfactory.

(3) Secondary or high school education for those children, who show the capacity for benefiting by it. Variety, both in types of school and in the curricula of individual schools, to suit the varying tastes and aptitudes of the individual pupils, is essential. In addition, so that no boy or girl of outstanding ability may be debarred by poverty from further education, liberal financial assistance in the form of free places, scholarships and stipends must be forthcoming.

(4) University education, including post-graduate and research facilities for picked students.

(5) Technical, commercial and art education.

(6) Adult education, both vocational and non-vocational, of all kinds and standards to meet the needs of those who were denied adequate opportunities in their earlier years.

(7) Arrangements for training the vast army of teachers, which a system of this kind will require.

(8) An efficient school medical service, which will see the children are made healthy and keep healthy.

(9) Special schools for children suffering from mental or physical handicaps.

(10) Recreational facilities of all kinds.

(11) Employment Bureaux, to guide school and college leavers into profitable employment.

(12) An administrative system which will place initiative and authority in the hands of those who understand and care about education.

These requirements, states Mr. Sargent, can hardly be described as extravagant. They were all covered by the British system of Education as it existed before the war, while in many parts of the United States of America and in some European countries a still more liberal system of public instruction was available.

Then Mr. Sargent examines how far the Indian system, as it exists to-day, falls short of these desiderata and whether it is practicable to build upon it a national system on the lines which have been already outlined. Speaking of compulsion, he says that it exists only in a very limited number of areas, usually towns, and covers only the primary stage, and in the majority of cases, compulsion is admittedly a failure. Further, an examination of figures of enrolment by classes shows that less than one out of every four children stayed long enough at school to reach the earliest stage, *viz.*, Class IV, at which permanent literacy is likely to be attained. The result is that the money spent on the others (nearly 80 per cent.) may be regarded as almost entirely wasted.

He then speaks of teaching service in India and states that the average pay of a primary teacher in Government schools in India is about Rs. 27 per mensem and in private schools is below Rs. 10 per mensem; and such a service can hardly attract the sort of people who ought to be in charge of the nation's most valuable asset, *viz.*, its children during its most malleable stage. In Great Britain the scales of salaries of ordinary assistant teachers in primary schools range from £150 to £408 per annum.

As regards adult education, Mr. Sargent says that at least 85 per cent. of the population of India is illiterate, and if the problem of illiteracy is to be dealt with as effectively and quickly as appears to have been the case in Russia, it will have to be attacked at both ends, *i.e.*, by the establishment of universal, compulsory and free primary education, and by the provision at the same time of abundant facilities for those whose education was neglected in their earlier years.

Mr. Sargent points out that if a national system of education is to be introduced within a reasonable period it will have to be not merely subsidised but also stimulated and co-ordinated from the Centre. This means a strong education department in the Central Government. He then concludes that the present Indian system of education when considered either on its merits or in comparison with systems in other countries, is deficient in almost every branch and that if any real progress is to be made a large part of what exists to-day will have to be scrapped.

Then the expenditure on education to bring it to the same level as existed in other countries before the war is considered in detail, and Mr. Sargent concludes that for British India the scheme would cost by the time it is fully established, *i.e.*, at the end of forty to fifty years, Rs. 313 crores annually, of which Rs. 277 crores will probably have to come out of public funds.

As regards the actual working of the scheme it is suggested that the work might be spread over eight five-year programmes, the first being devoted to working out plans in detail, regarding the administrative system and setting up the training schools and colleges necessary to provide the teachers required. During each of the succeeding seven periods an area roughly equivalent to one-seventh of the area of each province would be taken in hand.

Concluding, Mr. Sargent says, "If my premises are accepted, there can be no half-way house between what is and what ought to be. It is all or nothing. All means expenditure on a scale which frighten those who have defended inertia on the ground that India is too poor to have what other countries enjoy. Anything less than all means—and there is no evading this conclusion—that India accepts a position of permanent inferiority in the society of civilised nations."

B. V. S.

13-44—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

CURRENT SCIENCE

Vol. XIII] FEBRUARY 1944 [No. 2

INDUSTRIAL RESEARCH ASSOCIATIONS

IN 1915, England laid the foundations of a permanent organisation for the promotion of scientific and industrial research, in response to an united demand by persons engaged both in science and industry. At the outbreak of the last War, many of Britain's industries were faced with a serious crisis; they realised the extent of their dependence with regard to certain essential articles, the manufacture of which had been monopolised by foreign countries, particularly by Germany. Scientific research in Germany had been more thoroughly and more effectively harnessed to the solution of industrial problems and to the development of economic and scientific methods of production. Arthur Henderson wrote: "It is impossible to contemplate without considerable apprehension the situation which will arise at the end of the war unless our scientific resources have previously been enlarged and organised to meet it. It appears incontrovertible that if we are to advance or even maintain our industrial position we must as a nation aim at such a development of scientific and industrial research as will place us in a position to expand and strengthen our industries and to compete successfully with the most highly organised of our rivals. The difficulties of advancing on these lines during the war are obvious and are not underestimated, but we cannot hope to improvise an effective system at the moment when hostilities cease, and unless during the present period we are able to make a substantial advance we shall certainly be unable to do what is necessary in the equally difficult period of reconstruction which will follow the war."

In 1917, the British Government put forward a scheme for the encouragement of industrial research by co-operative associations of manufacturers. With a view to give practical shape to the scheme, the Government placed at the disposal of the Department of Scientific and Industrial Research, a fund of a million pounds sterling which was to be utilised in rendering financial aid to such of those groups of industrialists who voluntarily chose to organise themselves into Research Associations with the specific object of undertaking research on problems of common interest. Industrial concerns participating in the scheme were obliged to subscribe an equal amount towards the prosecution of such researches; they were, in consequence entitled to certain privileges, such as, the right to elicit information on technical matters relevant to the industry, the right to recommend specific subjects for research, and the right to use any patents or secret processes resulting from the researches undertaken under the auspices of the Association. In addition, they would be entitled to receive a regular service of summarised technical information, thereby keeping themselves abreast of technical developments and to obtain a translated copy of any foreign article in which they may be specifically interested.

British manufacturers readily responded to these proposals and organised themselves into several Research Associations each representing a particular trade or type of manufacture. They were asked to make free use of the facilities offered by the several laboratories attached to the universities, technical colleges and research institutes. The industrialists soon began to realise in a practical manner the value of research as the most effective means of combating competition, of enhancing the quality and prestige of their products and stabilising their industry. The Government were thus able to demonstrate the importance of scientific research in relation to industrial advancement and national prosperity. The Research Association scheme which was launched some thirty-five years ago, has proved a great success. The financial contributions to research by private enterprise to-day far exceed those endowed by the Department of Scientific

and Industrial Research. Many of the Research Associations have reached such a state of self-sufficiency that they are able to carry on their work without receiving any further subsidies from the Government. Some of them have built their own lavishly equipped and efficiently staffed research laboratories. For the continued maintenance and expansion of a prosperous export trade, the work carried out by these Research Associations, have proved invaluable. Very recently, a plea for the increased awareness of the part that must be played by industrial research in post-war Britain has been made in a report compiled by a special committee of the Federation of British Industry: "Research, it is stated, has an even greater part to play in the future, than it has played in the past. Britain's position as the leading exporting nation can only be recaptured by establishing a high degree of superiority and originality in industrial products. British industry will be required not only to maintain the highest measure of productive efficiency but to introduce new materials, to develop new products and through collaboration between scientific, technical and productive personnel of industry, generally to mobilise the whole of our industrial resources in the interests of national prosperity."

Thanks to the farsighted statesmanship of Sir Ramaswami Mudaliar, the Board of Scientific and Industrial Research was constituted soon after the commencement of the present conflict, to promote the advancement of pure and applied research in this country. Under the able and inspiring leadership of Sir S. S. Bhatnagar, the Board has made substantial progress. Plans for post-war research are being drawn up and proposals for the formai of a National Research Council for direct and co-ordinating the research activities h been put forward. Several important sche of research are now in progress in the vari laboratories throughout the country. These being financed by the Board of Scientific Industrial Research. Leading industrialists h become increasingly conscious of the imp ance of research and they are making e effort to consolidate the position of their pective industries. Some of the progres manufacturers have made liberal endowm for research. But it is doubtful if they be in a position to meet post-war competi which is expected to be both severe and r less unless the Central Government helps t to organise themselves into the several Rese Associations each representing a partic type of product. Addressing a meeting of All-India Manufacturers' Organisation rece held in Bombay, Sir S. S. Bhatnagar sugge the formation of Research Associations. Government should extend their financial port and give sufficient protection to som the more important key industries, if should have any chance of survival during post-war period. The manufacturers sh immediately organise themselves into re sentative groups and put forward prop for stabilising their industries on a foundation. The formation of Research A ciations will naturally constitute the first in this direction. The several research mittees functioning under the auspices of Board might perhaps take the initiative in inauguration of these Research Associatior

---

'PATULIN'—A REMEDY FOR COMMON COLD

COMMON COLD is an ailment costing the nation a heavy price in sickness, unemployment and loss of several man-hours. It often leads to pneumonia, bronchitis and other respiratory complications, and weaken the system and render the body susceptible to other infections. A 100 per cent. cure for cold has been sought unsuccessfully for many years and although numerous palliative drugs have been tried from time to time, the results were uniformly disappointing. But of late, we have all read with great interest the announcement of the success of 'Patulin' in the treatment of common cold. If this achievement passes the extensive tests, it will constitute a great contribution.

Prof. Raistrick and his colleagues have isolated a metabolic product of *Penicillium notatum* Bainier and shown its antibacterial properties for both gram positive and gram negative organisms. This active inhibitor has now been identified as anhydro-3-hydroxy-methylene-tetrahydro-γ-pyrone-2-carboxylic acid and named 'Patulin'.

The story of 'Patulin' as a remedy for cold is very interesting. An almost accidental observation by Prof. Gye of the Imperial Cancer Research Fund Laboratories suggested that 'Patulin' might be useful in the treatment of common cold. When this new drug was sent to him for study, Prof. Gye had a severe mon cold. Knowing its antibacterial pro ties Prof. Gye tried it on himself. The come was encouraging and he repeated experiment on other members of his Further experiments were conducted by geon-Commander Hopkins at a Naval Estab ment in the South East of England. response to treatment has been encoura Hopkins showed that 'Patulin' has no effe the early period of cold, probably cause virus infection; but secondary stage w constitutes invasion with gram positive gram negative organism can be entirely vented. These trials, spread over a perio months, gave good results and a strong bal of evidence in favour of treated group; 57 cent. of treated cases recovering compl within 48 hours as compared with only per cent. of the controls.

The exact mode of action of 'Patulin' in is not yet known. The action *in vitr* 'Patulin' against a number of pathogenic bic organisms has been studied; the re show that it possesses bacteriostatic e Serum and pus do not interfere. What lacks is evidence that 'Patulin' has antibact activity *in vivo* and this knowledge is ne sary for an understanding of the mechanis its action and its therapeutic scope. N. I

GLANDS AND GLAND PRODUCTS

I. The Endocrine Glands of South Indian Animals

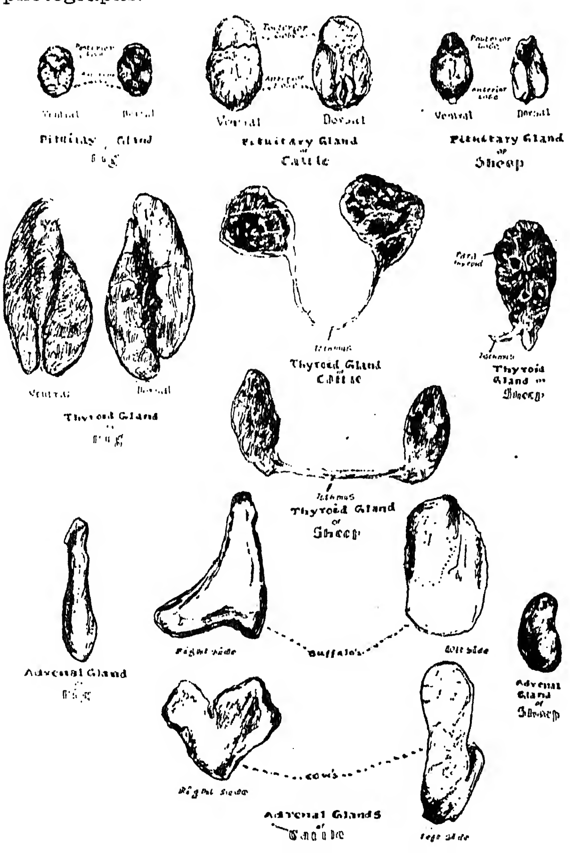
BY

B. B. DEY, P. S. KRISHNAN AND M. GIRIRAJ

(Department of Chemistry, Presidency College Madras)

NO systematic data are to be found in literature regarding some of the physical and morphological characteristics such as the weights of the various glands, the proportion of medulla and cortex in the case of the adrenal glands, the ratio of anterior to posterior lobes in the case of the pituitary glands, etc., of such of the endocrine glands as are available from the slaughteries for use in the manufacture of hormones. Even where isolated data are available, they are found to be widely scattered. Some of the observations which have been made during the past three years with the glands collected from the Madras Corporation Slaughter House, are therefore considered worth recording, especially in view of the fact that these glands have shown marked differences from the figures reported in literature in respect of several of their physical characteristics.

The morphological characteristics of some of the commoner glands of the South Indian animals—the thyroid, the adrenal and the pituitary—are illustrated in the following photographs.



It will be noted that the thyroid glands in the case of both cattle and sheep, possess a long and narrow isthmus, whereas in the case of the pig, the two lobes are fused together lengthwise, so that the description given in literature that the shape of the thyroid glands resembles that of a purse with the flaps opened up, seems to apply only to the pig thyroids. It will also be noted that whereas the adrenal glands of sheep are of a uniform elongated, oval structure, those of the cattle are uneven in contour, showing deep clefts in several cases. Again, the left adrenal differs in appearance from that of the right, and the adrenals of the cow often show a marked difference in shape from those of the buffaloe.

In the following table are given figures for the weights of the adrenal, the thyroid and the pituitary glands in the case of cattle, sheep and pig.

TABLE I

	Thyroid (2 lobes together)	Adrenals (a pair belonging to one animal)	Pituitary
Cattle	8 to 12 g.	8 to 11 g.	0·8 to 1·2 g.
Sheep	1·5 to 2·5 g.	1·5 to 2·5 g.	0·25 to 0·40 g.
Pig	3 to 5 g.	2 to 4 g.	0·1 to 0·25 g.

If these figures for cattle are compared with the corresponding values given in literature for animals in Europe, *viz.*, 30 g. as the weight of ox thyroids, 25 g. as the weight of ox adrenals and 2·5 g. as the weight of the ox pituitary, it will be seen that these endocrine glands of the Indian animals, or at least of those of South India, are very much smaller than those of the European and American domesticated animals.

In the following table are given values for the percentage of medullary tissue in the case of the suprarenal glands of cattle, sheep and pigs, the rest being made up of the cortex.

TABLE II

	% Medullary tissue
Cattle .	25 to 29
Sheep ..	17 to 20
Pig ..	17 to 20

Cattle adrenals thus possess the maximum amount of medullary tissue.

In Table III is given the ratio of anterior to posterior lobe in the case of the various pituitary glands. (Only a few pig glands were available so that the values reported may not be quite representative).

TABLE III

	Anterior lobe/Posterior lobe (ratio)
Cattle ..	2·3 to 2·8
Sheep ..	8 to 11
Pig ..	1·2 to 2·0

In the case of the ox pituitary of European animals where the whole gland weighs 2·5 g., it has been reported that the posterior lobe weighs only 0·5 g., so that the ratio of anterior to posterior lobe should be 4. In the case of the Indian cattle, therefore, although the total weight is nearly half, the proportion of the posterior lobe is considerably higher, so that they appear to be ideal for the preparation of the posterior pituitary products. Sheep pituitary will be seen to be a very poor source of the posterior lobe; it is, on the other hand, best suited for the preparation of the anterior pituitary hormones.

It is interesting to note that the glands of the three classes of animals, cattle, sheep and pigs, used for slaughtering, not only show marked variations in size and shape, but also in their contents of some of the essential chemical constituents. Data for three of these constituents, *viz.*, vitamin C in the case of the whole adrenal and pituitary glands, adrenaline in the case of the adrenal glands and iodine contents of thyroids, some of which have already been reported in publications appearing from this laboratory from time to tim are collectively presented below (Table IV).

TABLE IV

	Vitamin C content of the adrenals (mg./g. of fresh tissue)	Vitamin C content of pituitary (mg./g. of fresh tissue)	Adrenaline content of adrenal glands (mg./g. of fresh tissue)	Iodine content of thyroid (% of desiccated glands)
Cattle	1·24	1·43	2·24	0·91
Sheep	1·36	1·75	1·60	0·66
Pig	..	..	0·8	0·84

It will be noted that sheep glands are ricl in vitamin C than the corresponding glands cattle and again the pituitary is richer in t vitamin than the adrenal.

Our thanks are due to the authorities of t Madras Corporation for facilities for the c lection of the various glands from the Slaugh House and to the Superintendent of Slaughter House for help in the cellection a identification of the glands. We are a deeply indebted to Rao Sahib Chelva Aiyan of the Madras Veterinary College, for his valuable instructions in the methods of ider fication and dissection of the glands. T expenses of this investigation were met by grant from the Board of Scientific and Ind trial Research, to whom our thanks are due

THE ORIGIN OF CURVES IN RIVERS

BY MOHAMED SALEH QURAISHY, B.E., PH.D., D.I.C.

INTRODUCTION

IT is well known that in most cases, natural water-courses, flowing freely through incoherent material, adopt a sinuous or meandering course, with curves alternating with right and left. There are various hypotheses purporting to explain the origin of this somewhat universal characteristic of natural streams. By way of illustration, we have one of these explaining this phenomenon as due to the earth's rotation, referred to as Baer's Law (Baer, 1857-58) or Coriolis' Effect (Coriolis, 1835); according to the other, the curves are initiated by alternate eddies of the type generated behind a bluff body (Stanley, 1881; Exner, 1919); according to James Thomson (1877), the development of curves is due to secondary flow; according to Möller (1883), an initial asymmetry of the cross-section is responsible for the origin of curves; according to many (amongst whom are also hydraulicians), the curves are due to the river having been initially deflected from its straight course by either an obstacle (Dubuat, 1786; North, 1928) or an initial incurvation (Exner, *op. cit.*; Tiffany and Nelson, 1939); whereas according to some, this tendency is due to the river becoming old and infirm, when in carrying its sedimentary burden, it rambles about.

The question occupies an exceptionally i portant position in River Engineering I have investigated it experimentally. I f that Thomson's explanation, which stric speaking concerns *the development of existing curves*, is true, as far as it goes. for the initiation of curves, observations sh that the earth's rotation could not be the c cerned cause (Quraishy, 1943), whereas presence of an obstacle, initial incurvati initial asymmetry of the cross-section, etc., not necessary to the occurrence of the cur

The curves originate even in a channel w the sides quite straight and the bed very ev They actually arise as a result of certain int actions between the flowing water and sediment particles, by a series of easily asc tainable actions.

A study of these actions supplies quite rational explanation of such formations convex shoals and secondary channels and a explains many other interesting phenome ordinarily speculated upon. A short accou describing how the curves come into being given here, whereas a fuller discussion (incl ing also an investigation on the nature of interactions) is incorporated in a paper to published elsewhere.

Apparatus

The experiments were performed in an open welded steel flume, 30 ft. long and of rectangular cross-section, 2 ft. 6 in. wide by 1 ft. 6 in. deep. Two jack-screws, one at each side, supported it at its upper end. By these, the channel could be given a variety of initial slopes.

In the channel bottom, wet sand of mean grain diameter 0·70 mm. was placed to a depth of 6 in., and the working channels (straight and with even bed), in this sand, were swept out by wooden templets of the necessary dimensions. Water was supplied at a uniform rate from an overhead tank and so was dry sand, representing 'bed-load', by a device, which was suggested to the author by Dr. C. M. White.

Its construction rested upon the principle that any incoherent material, when free to flow, always tends to assume its angle of repose. And so, no sooner one lot is removed away, than another automatically takes its place. The sediment was stored in a box with an adjustable slit, through which it flowed out freely and was removed away by a flue brush driven at a regular speed by a small motor.

Besides these, use was made of a measuring tank, a thermometer, a point gauge, a spirit level and a balance, to record various details.

Bed Deformation: Formation of the Skew Scales

Generally, with the commencement of an experiment, the topmost grains began to roll and skip all over the bed, moving in jerkey but on the whole, straight paths parallel to the channel sides. But within a short time, sometimes almost as soon as the experiment commenced, there was vigorous local scour of the bed close to the channel sides, alternating with left and right, in all probability due to vortices suspected to be skewed out of the vertical.

These seemed to originate in consequence of the breaking up of the stream at these positions, due to its being deficient in energy and momentum. Experiments, where the formation of ripples was suppressed, without arresting the sediment motion, by sucking away the retarded stratum close to the bed, lent strong support to this view.

The material appeared to be scooped out and pumped towards the centre where it came to rest in a systematic manner. When carefully examined, the fish-scale pattern was found to be twisted towards the one or the other side of the channel, something like Fig. 1 A. We call these *the skew scales*.

These skew scales were just a few grains thick but their pitch was anything from 50 to 500 times their thickness. Slowly they grew up, as they were continuously nourished by the scoured material from places which in Fig. 1 A are denoted by *St.* We name these *the stems.* For purposes of standardisation, we call the upper ends of these *the roots.* The position of these roots lay nearly opposite to

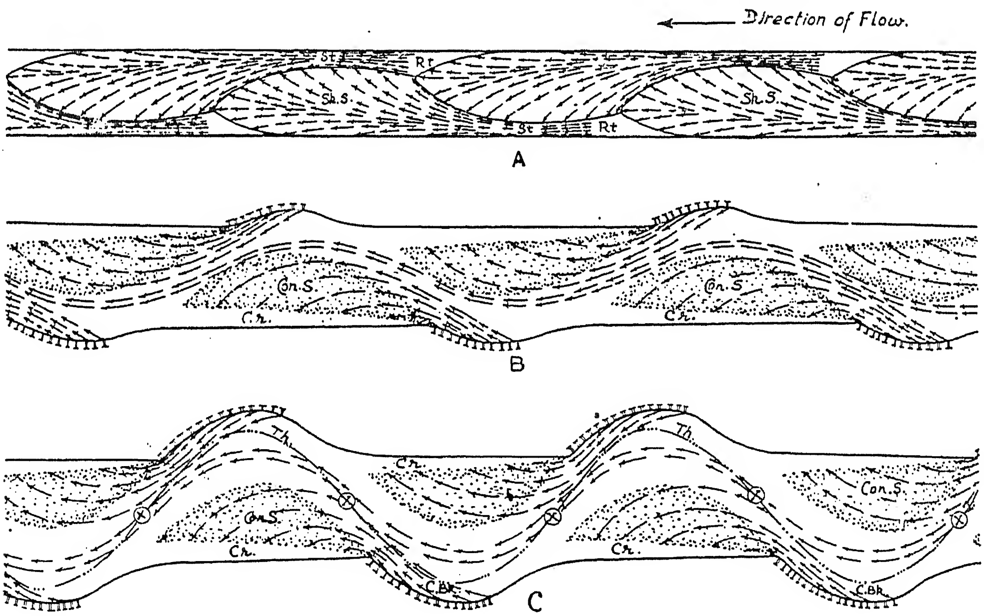


Fig. 1. Illustrating the Sequence of Features Leading up to a Meandering Stream

A shows well-developed skew scales, *i.e.*, skew shoals. The tracks of particles coming from the stems (*St.*) are curvilinear. As the skew shoals attain an optimum size, bights develop and the finer details of the shoals get masked. This is illustrated by *B*. Then the curves develop. As shown in *C*, the material removed from the concave banks follows the arrows and is mostly deposited downstream as indicated. Between the shoals and the channel bank, there are secondary channels or creeks (*Cr.*), where would gather foam and dirt.

C. Bk.—Concave Bank; *Con. S.*—Convex Shoal; *K.*—Kink; *Rt.*—Root; *Sk. S.*—Skew Shoal; *St.*—Stem; *Th.*—Thalweg; ⊗ Crossing; πππ Caving Bank; ← Particle Track.

a kink, marked in the figure as *K*. The paths of sediment grains coming from these stems were curvilinear: the strokes in Fig. 1 A have been drawn to exemplify these paths.

This sequence was, however, found in experiments in which the variables were fairly well represented. In other experiments, there were some intermediate formations, hardly like the skew scales, but all invariably leading to the skew shoals (advanced stage of the skew scales).

There were also cases, where the skew scales appeared successively. For example, they would originate upstream and migrate downstream, till the whole channel bed had been covered with them, or again initiate at the downstream end first and appear elsewhere subsequently. All such processes were, however, very slow and this peculiarity had some bearing upon the subsequent behaviour of the stream—upon the manner in which the particles moved and upon the various associated phenomena. It seemed to us as though the more rapid movements produced close consilience, whereas the slower ones gave rise to dissimilarities.

The Skew Shoals and the Initiation of Curves

All such skew scales, with more or less a constant pitch in the flow direction, bulged out in other directions. In their mature form, they looked something like long-drawn out dunes, in which state we name them *the skew shoals*. As soon as the height and breadth of these shoals became sufficiently great, the channel sides began to be scoured alternately, just opposite the widest part of the shoals. Simultaneously, it appeared as though the forward migration of the shoals had ceased: the well-defined skew shoals had been deprived of their beautiful pattern and now presented only a smooth, washed out appearance (Fig. 1 B).

This marked the initiation of curves. Both the skewness and the curvature of the shoal boundaries seemed essential for this to happen. But the mechanism involved appeared somewhat complicated and could not be fully grasped. What was, however, clear was that a type of secondary flow was set up: the faster fluid moved outwards and scooped out material from the bank. Once this action started, the effect was progressively intensified due to the outer boundary becoming more and more curved, so that, ultimately we had a channel like the one illustrated in Fig. 1 C, where the arrows, once again, depict the tracks of the sediment particles.

Other Interesting Facts

Fig. 2 A, reproduced from a previous note by the author (1943), shows such a channel with the water flowing through it, whereas Fig. 2 B shows the same channel with the water drained off. In this laboratory river, one can clearly observe all the prominent features generally associated with large rivers (*cf.* Fig. 1 C). These include concave banks, convex shoals, secondary channels or creeks, deeps, shallows, crossings, etc.

The secondary channels or creeks, often erroneously adduced by river engineers to the inequalities in the settlement of suspended silt, when the flood waters subside, are the resu of the peculiar manner in which the particl are transported and deposited and come in

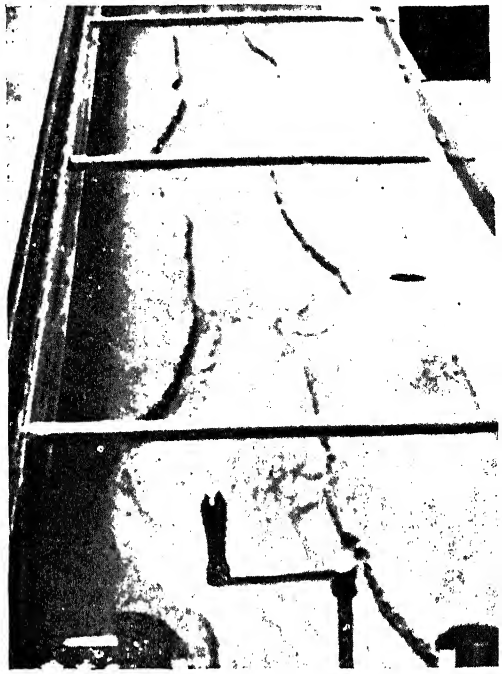


FIG. 2. Photographs of a Meandering Stream

A—With water; *B*—Without water

being as soon as the scales are formed (a Fig. 1 A). These were filled with retar water and remained opened at their do stream ends. An effect of surface tension c be seen in the accumulation of foam and on the surface of this retarded water: in photograph in Fig. 2 A, bright bands aga the banks (just below the concave banks) due to this.

The edges of these creeks appeared to m outwards, towards the banks. But whereas are apt to think of the creeks ultimately fac away, we saw that in actual fact this was so: there was a certain increase in the am tude and the shoals continually travelled do stream, so that the triangular creeks maint ed their identity.

The concave banks (Fig. 1 C) appeared cave in: the material was either wh washed into water or slipped down. The ba became more or less vertical, with their curved, and the particles caught and mo forward, were distributed as shown. A result of this kind of radial and tanger erosion, the curves expanded radially simultaneously migrated downstream. Fig is an example of the sequence of the wa surface profiles, in plan, assumed progressi with time. The insets show cross-sections typical places, with the water surface eleva towards the concave sides, due to the cen

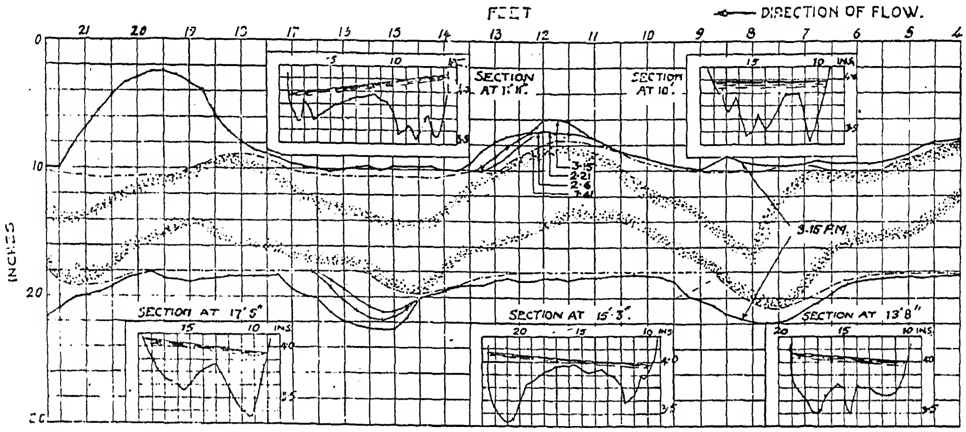


FIG. 3. Periodical Profiles in Plan of a Typical Meandering Stream

(Discharge 0·021 cusec., sediment feed 1·0 gm./sec, initial channel slope 1 : 300, and initial width at the bed 6 in.)

Region within dotted border presents channel bed where the sediment motion was extremely lively at that stage. Bold lines mark the position of water surfaces at the times indicated by the attached figures. These illustrate also the lateral and tangential expansion of the curves.

fugal force (in virtue of the curvature of the curves).

CRITICAL TESTS

Critical tests were made to determine with certainty that the skew shoals preceded the initiation of curves. In these first one and then both sides were reinforced. The photograph in Fig. 4 shows the skew shoals with fine sand, approximately 0·21 mm. in diameter. The channel had both sides rigid and was barely 2 in. wide. It was given a very steep slope, but the discharge was just a few c.c. per second.

All these tests led to the conclusion that the skew shoals were precisely responsible for the origin of curves in rivers, which initially can be quite straight and have an even bed.

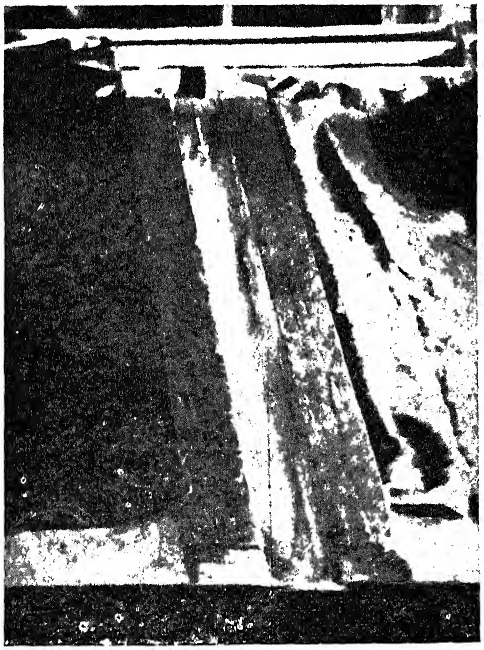


FIG. 4. Photograph Showing the Skew Shoals

ACKNOWLEDGMENTS

The study was made possible by the grant of a scholarship by the University of Bombay for higher studies abroad and by the facilities freely placed at my disposal in the Hydraulic Laboratory of the Imperial College of Science and Technology (City and Guilds College), London, by Dr. C. M. White. I am greatly indebted to them.

1. Baer, K. E. von, *Morsk. Sborn.*, 1857–58, 3 Sec., **27**, 110–20, and **35**, 83–104. 2. Coriolis, G. G. de, *J. Éc. Polyt. Paris*, 1835, **15**, 142. 3. Dubuat, P. L. G. Comte, *Principes d'Hydraulique, etc.*, 1786, Nouv. Éd. Paris, imper. de Monsieur. 4. Exner, F. M., *Sitz. Ber. Akad. Wiss. Wien*, 1919, Abt. 2a, **128**, 1453–73. 5. Möller, M. E. K., *Z. Bauwesen*, 1883, **33**, 193–210. 6. North, F. J., *Discovery*, 1928, **9**, 95–97. 7. Quraishy, M. S., *Curr. Sci.*, 1943, **12**, 278. 8. Stanley, W. F., *Experimental Researches, etc.*, 1881 (London, E. & F. N. Spon, Ltd.). 9. Thomson, J., *Proc. Roy. Soc., Lond.*, 1877, (A), **25**, 5–8. Also, *Scientific Papers in Physics and Engineering* (London, Cambridge University Press), pp. 96–99. 10. Tiffany (Jr.), J. B., and Nelson, G. A., *Trans. Am. Geophys. Un., Sec. Hydrology*, 1939, Pt. IV, 44–49.

THE CYTOGENETICS OF AN AMPHIDIPLOID *SESAMUM ORIENTALE* × *S. PROSTRATUM*

By S. RAMANUJAM

(*Imperial Agricultural Research Institute, New Delhi*)

In a previous communication the author[1] reported that a hybrid between *S. orientale* (= *S. indicum*, n = 13) and *S. prostratum*, n = 16) was obtained for the first time and subjected to colchicine treatment for production of amphidiploids. The present note is a preliminary description of the cytogenetical behaviour of the amphidiploids.

A_1 Generation

Eight hybrid plants were treated with 0·4 per cent. aqueous solution of colchicine when they were in the seedling stage with 6 to 8 leaves. After treatment, the seedlings grew very slowly with all the symptoms of induced polyploidy; the mature plants had thicker and broader leaves, bigger and more hairy flower buds and flowers than the untreated plants. One flower in each branch of the different treated plants was examined for pollen size and fertility and it was found that the percentage of fertile grains varied in amount in the different flowers but they were bigger than those of either parent. Fig. 6 in the previous note shows photographs of pollen grains in the parents, in the F_1 hybrid and in a fairly fertile flower on a treated plant. The capsules formed on the different branches of the eight treated plants were examined for seed-setting. Although a good number of seeds set in most of the capsules, a closer examination revealed that a large proportion of them were only 'developed ovules' with no embryos in them. The branches in all the eight plants were grouped into three classes on the basis of pollen fertility and the number of capsules, true seeds and developed ovules formed in each class is given in Table I.

TABLE I

Percentage pollen fertility	5–20 (Class I)	21–40 (Class II)	41–60 (Class III)
No. of branches	147	15	4
No. of capsules	89	19	3
No. of true seeds	7	33	33
No. of developed ovules	1128	405	39
Percentage of true seeds per capsule	0·63	7·3	45·8

It is interesting to notice that a large number of 'developed ovules' are formed on these plants and that the proportion of true seeds to developed ovules increases with the increase in pollen fertility.

A_2 Generation

Morphology of A_2 Plants.—A large number of 'developed ovules' and good seeds were sown

TABLE II

Details of characters	*S. orientale*	*S. prostratum*	Amphidiploid *S. orientale* × *S. prostratum*
Habit	Erect	Prostrate	Semi-erect and more vigorous than the parents.
Leaves	Petiolate, oblong to ovate, lower lobed palmately and upper simple with almost entire margin	Short petioled, simple, orbicular with crenate margin	Petiolate, simple throughout with a slight tendency to lobation in a few of the basal leaves, orbicular with dentate margin.
Inflorescence	Raceme; flowers solitary, axillary with two discoid gland-like structures representing rudimentary flowers	Raceme; flowers solitary axillary with no rudimentary gland-like structures	Raceme; flowers solitary, axillary with imperfectly developed glandular structures.
Flowers	Pedicellate, bracteate, zygomorphic, hermaphrodite, with very light purple corolla	Pedicellate, bracteate, zygomorphic, hermaphrodite, with purple corolla	Bigger in size, pedicellate, bracteate, zygomorphic, hermaphrodite (female-fertile, variably male sterile), with light purple corolla.
First flowering (days from sowing)	40	90	60
Fruit	Capsule four-chambered, quadrangular, 2·6 cm. long, 0·6 cm. broad opening from above; loculicidally down to about the base	Capsule ovoid, compressed, with tough pericarp, 1·9 cm. long, 1·0 cm. (at base) and 0·7 cm. (at apex) broad, opening loculicidally from top to only a short distance below	Capsules four-chambered, quadrangular, with tough pericarp, 2·1 cm. long, 1·0 cm. broad, opening loculicidally from top to less than half the capsule-length below.
Seeds	Many, white, smooth, with thin testa	Fewer, black, deeply reticulate, with thick testa	Many, black, larger than in both the parents, deeply reticulate, with thick testa.
Average weight of 100 seeds	0·3301 gm.	0·2340 gm.	0·4408 gm.

during 1943-44. While all the developed ovules failed to germinate, a majority of the good ones germinated and gave rise to 35 mature plants. All plants, except four, were very vigorous and more or less uniform for habit (semi-erect), flowering and other morphological characters. A reference to the four exceptional plants will be made later in the note.

Table II gives a brief summary of the morphological features of the parental species and the group of 31 plants obtained from colchicine-treated hybrids.

Cytology of A, Plants.—Thirty-one out of 35 plants had 58 chromosomes as their somatic number which is equivalent to the sum of the somatic numbers of the two parental species. Hence it is clear that all these plants are amphidiploids resulting from the duplication of chromosomes in the F_1 hybrid. The meiosis in the amphidiploids was very regular with the formation of 29 bivalents at metaphase I, which underwent even separation at anaphase I; metaphase II in many cells showed two groups of 29 chromosomes in each, although very occasionally 30 + 28 grouping was noticed. Figs. 1 and 2 represent metaphase I and II, respectively, in an amphidiploid plant. In spite of the regular meiosis, a high percentage of pollen sterility (60-90 per cent.) was noticed in the amphidiploid plants. But the capsules developed in a large majority of the flowers and contained many apparently good seeds. A closer examination again revealed that many of the seeds were only 'developed ovules'. The seed-setting in 22 amphidiploid plants is given in Table III.

TABLE III

Percentage of true seeds per capsule (average of 10 capsules)	10	10–19	20–29	30–39	40–49	50–59	
Number of plants	1	4	8	5	3	1	Total 22

The four exceptional plants resembled the *prostratum* parent in habit although more vigorous than the latter. They had forty-five somatic chromosomes and showed a typical 'Drosera scheme' of pairing at meiosis; 16 bivalents and 13 univalents were invariably noticed at metaphase I. Fig. 3 represents metaphase I in one of these plants. Evidently these plants had resulted from natural crossing between 'doubled' hybrids and *S. prostratum*.

DISCUSSION

The entirely different morphology and chromosome of the amphidiploid together with its regular meiosis and true-breeding nature justify its being classified as a new species. The one peculiar feature in this amphidiploid is its high pollen sterility in spite of regular meiosis, although it appears to be highly female fertile. In this respect, the present amphidiploid resembles the cotton amphidiploids produced

by Beasley[2] and Harland.[3] Beasley reported that allotetraploids produced by doubling the chromosome number in F_1 hybrid *G. arboreum* var. *neglectum* × *G. Thurberi* were ordinarily male sterile but rarely flowers had viable pollen. Harland, however, reported that his amphidiploid involving the same two parental species was completely male sterile. Greenleaf[4] found that amphidiploids *N. sylvestris—tomentosa* and *N. sylvestris—tomentosiformis*, in spite of being regular in meiosis in mega- and micro-sporogeneses and having over 90 per cent. good pollen were completely female-sterile. He concluded that the sterility in his amphidiploids was genic and that the sterility in the corresponding F_1 hybrids was genic as well as chromosomal. It is possible that in the present *S. orientale-prostratum* amphidiploid also the sterility is genic but that the genic effect is only on pollen formation and not on ovule development.

Further work on these amphidiploids in respect of their crossability with the parental species and the development of ovules and pollen degeneration are under way. Attempts to produce the amphidiploid from triploid hybrids (di-*prostratum*-mono-*orientale* plants) by backcrossing them with *S. orientale* are also in progress. A further report of the results will be published elsewhere.

It is, however, proposed to classify this true-breeding synthetic plant as a new species under the name *S. indicatum*.

1. Ramanujam, S., *Curr. Sci.*, 1942, **11**, 426–28. 2. Beasley, J. O., *J. Hered.*, 1940, **31**, 39–48. 3. Harland, S. C., *Trop. Agriculture, Trin.*, 1940, **17**, 53–54. 4. Greenleaf, W. H., *Genetics*, **26**, 1941, 301–24.

LETTERS TO THE EDITOR

GROUND TRIPLET IN BROMINE II

SOME of the main features in the first spark spectrum of Bromine were reported by Bloch and Lacroute[1] previously; but the most important deepest terms of the spectrum have not yet been identified correctly. Following the work[2] in our laboratory on the successive spectra of Bromine, it has been possible to establish the fundamental inverted triplet term $4p\ ^3P$ of Br. II, involving the classification of about thirty lines in the vacuum grating region. The intervals are found to be $4p\ ^3P_2 - 4p\ ^3P_1 = 3147$ and $4p\ ^3P_1 - 4p\ ^3P_0 = 695$ units. Bloch's identification of $5s\ ^1D_2$ had to be changed from 65657·1 to 61179·5. Full details of the analysis will be published elsewhere.

Andhra University,
Guntur, K. R. RAO.
January 11, 1944.

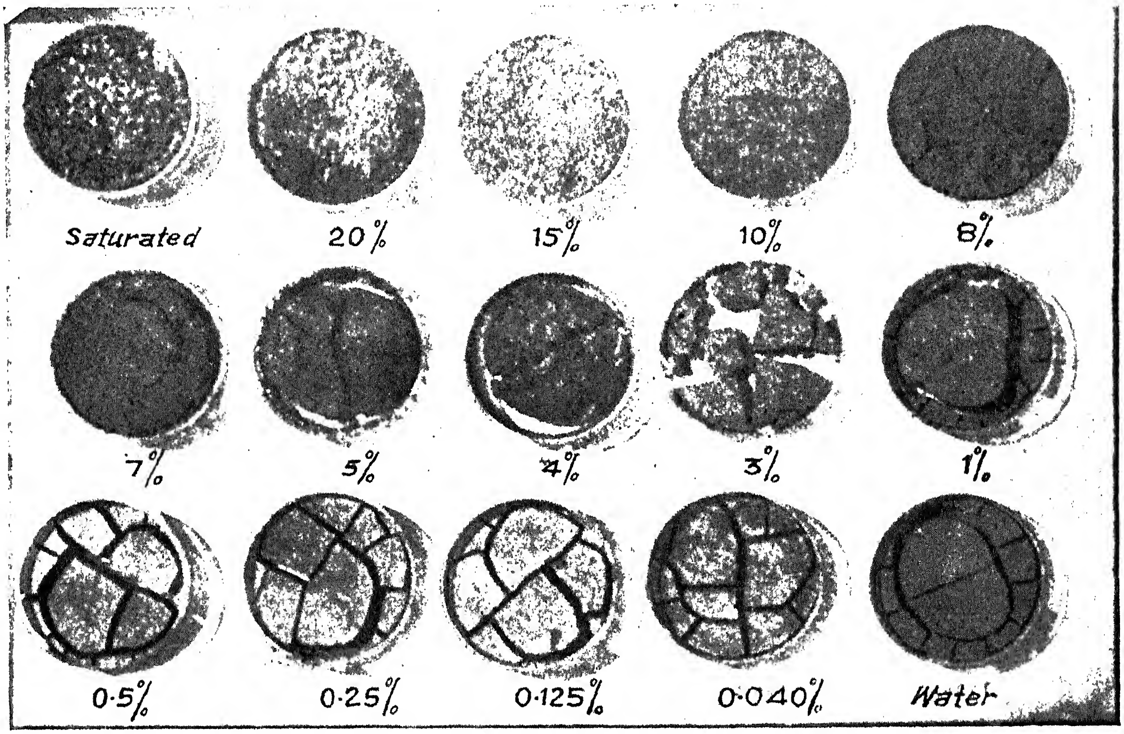
1. *Compt. Rend.*, 1934, **199**, 41 and *Ann. de Physique*, 1935, **3**, 5. 2. Rao and Krishnamurty, *Proc. Roy. Soc.*, A, 1937, **161**, 38 and *Proc. Phy. Soc.* (Lond.), 1934, **46**, 531.

ON THE EFFECT OF CONCENTRATION OF SODIUM CARBONATE IN AQUEOUS SOLUTIONS ON (A) THE FORMATION OF CRACKS, (B) SWELLING AND DISPERSION AND (C) CAPILLARY ASCENT IN THE BLACK COTTON SOIL

IN a series of papers published recently[1,2,3] the present writers discussed the capillary rise of sodium carbonate solution in black cotton soil packed in glass tubes and the swelling of the soil particles when immersed in solutions of lithium and sodium carbonates and of some other salts. While a trace of sodium carbonate in water (0·03 per cent.) actually increases capillary rise, as the concentration is increased from 0·03 to about 1 per cent. there is a rapid deterioration in the permeability of the soil due to swelling of particles. Similar results obtained with solutions of other salts will be discussed in a separate paper.

In the present note we report some interesting results obtained with sodium carbonate. In this case, experiments could be made on (*a*) the development of cracks in soils mixed with sodium carbonate solutions, (*b*) swelling or dispersion of the soil in the solutions, and (*c*) capillary ascent, over a wide range of concentration (owing to the high solubility of the salt).

When samples of black cotton soil weighing 100 gr. are mixed with 60 c.c. of sodium carbonate solutions of different concentration and the pastes so formed are allowed to dry in a steam oven, the soil layers develop the well-known cracks only in the range of concentration from 0 to 5 per cent. The width of the cracks formed increases to a maximum at a concentration of 3 per cent. No deep cracks appear above 5 per cent. Between 4 per cent. and 8 per cent. the soil mass contracts *en masse* on drying and a black layer appears at the surface. This contraction also decreases with increase of concentration in the above range. Finally, at concentrations higher than 8 per cent. the precipitation of the salt prevents visible contraction, and the soil particles have no tendency to form lumps but remain powdery and porous like sand. The maximum cracking should occur at a concentration where the swelling on wetting and contraction on drying are both large. The cracked layers are hard as brick. Between 4 per cent. and 8 per cent. the dried mass is very friable. Fig. 1 shows



the appearance of the soil layers mixed with different concentrations of sodium carbonate solution when dried.

In the next experiment 15 gr. samples of black cotton soil were shaken for a minute with 100 c.c. of different concentrations of sodium carbonate solution, and allowed to settle in measuring jars. After settling was complete (*i.e.*, after two days), the volumes of the sediments in the different concentrations were recorded. The values are given in Table I.

TABLE I

Concentration % of Na_2CO_3—0 (Water), 0·2, 0·4, 0·7, 1·0, 1·5, 2·0, 3 0, 4·0, 10·0, 20·0.
Volume of soil sediment c.c. -24, 29, 36, 41, 45, 41, 36, 32, 26, 22, 19.

The volume of the soil sediment increases with concentration up to 1 per cent. As the concentration is increased further the volume of the sediment decreases rapidly. The supernatant liquid in solutions of concentration greater than 1 per cent. is coloured deep brown; the cause of this colour is being investigated.

The capillary rise of different concentrations of sodium carbonate solution through columns of black cotton soil during a period of 24 hours is indicated in Table II.

From Table II it will be seen that the capillary ascent *decreases rapidly from* 0·03 *per cent. to 2 per cent.; but it is very ramarkable that as the concentration of the sodium carbonate solution is increased further there is rapid restoration of the permeability of the soil.* Thus, a concentrated solution of sodium carbonate is found to rise through the soil at even a

TABLE II

Contentration of sodium carbonate solution	Capillary rise during 24 hrs. in cm.	Concentration of sodium carbonate solution	Capillary rise during 24 hrs. in cm.
% (Water)			
		0·25	5·4
0	28·8	0·50	3·9
0·010	29·9	1·00	3·1
0·020	31·7	2·00	1·9
0·030	32·3	3·00	3·0
0·040	31·7	6·25	6·8
0·050	28·0	12·50	10·5
0·125	12·0	25·00	20·1

faster rate than pure water initially (as through sand) although pure water scores ultimately over the solution. The soil wetted by the highly concentrated solutions turns black after some time. This effect begins at the lower layers of the wetted soil and slowly moves upward along the wet column. It is to be noted in particular that although the soil becomes nearly impermeable to a 2 per cent. solution, *the permeability increases rapidly with concentration above 2 per cent.*

The importance of the above results in dealing with problems connected with lands affected by sodium carbonate is obvious. For a given quantity of black cotton soil there is an optimum concentration at which its auto-dis-

persion in sodium carbonate solution (*e.g.*, for mechanical analysis) will be most effective. Similarity in the influence of concentration on different phenomena like crack formation, swelling and capillary ascent is also noteworthy. A more detailed discussion of our results will appear elsewhere.

Our thanks are due to Mr. A. U. Momin for help in performing some of the experiments described above.

Meteorological Office, Poona,
January 24, 1944.

L. A. Ramdas.
A. K. Mallik.

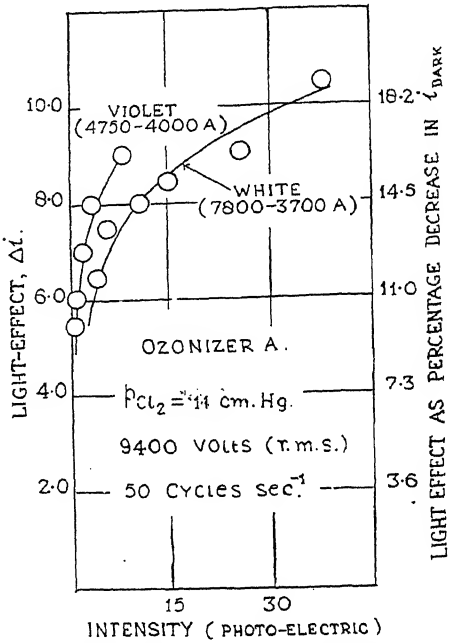
1. Ramdas, L. A., and Mallik, A. K., *Proc. Ind. Acad. Sci.*, *A*, 1942, **16**, 1–9. 2. —, —, *Ibid.*, 1942, **16**, 16–22. 3. —, —, and Pandit, U. P., *Curr. Sci.*, 1942, **11**, No. 7, 288.

NEW LIGHT EFFECT—INTENSITY VARIATION BY DIRECT PHOTO-ELECTRIC MEASUREMENTS

Earlier results[2,4,5] for the dependence of the new light-effect defined as Δi the instantaneous diminution on irradiation of i the conductivity in chlorine[2,4,6,9] and other gases[2,3,4,7] subjected to electrical discharge, upon I the corresponding light-intensity, have shown that Δi is not a linear function of I. This has been used by Joshi to discriminate this phenomenon from the well-known photo-electric effect,[2,4,5] in which the linearity of the above relationship has been found to hold over a millionfold variation of I.[8] Due to limitations of means then at our disposal, *the inverse square law* was assumed for the large size, light-source employed, *viz.*, an incandescent filament bulb. Results now to be reported are independent of the approximations involved in the above assumption, since I varied by varying the distance of the light-source was observed directly by a G.E.C. Osram photo-electric cell.

The chlorine-filled ozoniser A, the light-source—a 200 watt 180 volt bulb, the light filters and the general experimental procedure were the same as before.[5,9,11] The intensity of the filtered green (5775-5070 A) and the sensitivity of the available cell to the filtered red (7070-6070 A) were too low for a study of Δi as a function of I for these light-bands. With about 9400 volts (r.m.s.) and 50 cycles frequency, i the current *in the dark*, was 55 on a Cambridge A.C. microammeter. The light-effect, expressed as Δi and also as a percentage of the original i in the dark, is shown graphically in Fig. 1, at various I_{white} and I_{violet}.

It is seen from Fig. 1 that the Δi-I curve for the violet lies above that for the white; for a given I, Δi under violet exceeds that due to white. Evidently, therefore, the nature of irradiation is an additional factor involved in the production of this effect, and that, at same I for both, this factor in white is less effective than in violet. This mode of observation may be referred to by (*i*) for shortness. Now (*ii*) when, *at a given distance*, the chlorine tube is irradiated directly by the bulb and then with the violet filter interposed, Δi due to the white exceeds that under (filtered) violet. The discrepancy between (*i*) and (*ii*) is only apparent. In (*ii*), I_{violet} is less than I_{white} being only a fraction of same. The light-effect, which is found to be produced by all the components of the white light,[2,3,4,9,10,11] should be, therefore, and is, found to be greater under white than under violet.[5,9,10,11] Since $I_{violet} = I_{white}$ in (*i*), irradiation by violet is comparatively stronger in the short-wave components; it is besides more, within the absorption spectrum of chlorine, than the former.[12,13] On either or perhaps both these grounds, Δi under violet should be greater than under an equally intense white light, which is actually the case (Fig. 1).



These results afford a more quantitative support to Joshi's view[2,4,5] based on the observed non-linearity of the Δi-I relation, that this phenomenon cannot in the first instance be identified with negative photo-electric effect. The curves in Fig. 1 also show that the initially pronounced rise of Δi slows down at larger I due presumably to a saturation effect.[5,9,11]

Grateful thanks are due to Prof. Shrinivasan, Indian Institute of Science, Bangalore, for the loan of an A.C. microammeter and to Dr. S. S. Joshi for kind interest and guidance.

Benares Hindu University,
January 15, 1944.

P. G. Deo.

1. Joshi, *Curr. Sci.*, 1939, **9**, 548. 2. —, *Proc. Indian Sci. Cong. Pres. Address*, *Chem. Sec.*, 1943 70–75. 3. Joshi and coworkers, *ibid.*, 1940, *Phys. Sec. Abst.*, 17; —, *ibid.*, 1941, *Chem. Sec. Abst.*, 34, 35; —, *ibid.*, 1942, *Phys. Sec. Abst.*, 36, 38; —, *ibid.*, 1942, *Chem. Sec. Abst.*, 50, 51, 55–70; —, *ibid.*, 1944, *Chem. Sec. Abst.*, 31, 36, 37, 38. 4. Joshi, *B.H.U. Journal*, 1943, **8**, 99. 5. Deo, *Ind. Journ. Phys.* (Communicated). 6. Joshi and Narasimhan, *Curr. Sci.*, 1940, **9**, 536. 7. Joshi and Deshmukh, *Nature*, 1941, **147**, 809. 8. Elster and Geitel, *Phys. Zeit.*, 1913, 14, 741. 9. Joshi and Deo, *Nature*, 1943, **151**, 561. 10. —, *Curr. Sci.*, 1943, **11**, 306. 11. Deo, *Sci. and Culture*, 1943, **9**, 252. 12. Halban and Siedentoff, *Z. Phys. Chem.*, 1922, **103**, 71. 13. Elliot, *Proc. Roy. Soc.*, 1929, **A 123**, 629.

INFLUENCE OF EXCHANGEABLE IONS ON THE DISPERSION OF SOIL*

THE problem of stability of soil colloids unlike that of purer colloids is complicated because their suspensions are polydispersed systems. In clay systems both inorganic and organic constituents show pronounced base exchange properties, while their composition and structure are uncertain. Numerous attempts, in the past, have been made to study the coagulation of clay colloids by addition of electrolytes, but all the factors affecting the stability of colloidal suspensions have not yet been elucidated.

It is known that soils when saturated with monovalent exchangeable cation get dispersed due to "auto-disintegration". This dispersion is facilitated by a slightly alkaline medium. In the first series of experiments described here the dispersion of a pure calcium soil was studied when it was treated with increasing quantities of carbonates of sodium, potassium and ammonium.

The colloidal material was separated from a soil by decanting a suspension of sodium soil which had been kept standing for 24 hours. From this were prepared respectively pure calcium, sodium, ammonium and potassium clays, by the usual method of leaching with normal solutions of the respective chlorides and removing the excess salts by washing with alcohol.

10 gm. samples of pure calcium clay were shaken with increasing quantities of the carbonates of Na, NH_4 and K in a stoppered cylinder with 500 c.c. of water. The resulting suspension was subjected to pipette analysis as is done in the mechanical analysis of soils. 20 c.c. of the suspension were pipetted out from fixed depths after definite intervals of time. It was coagulated by adding $CaCl_2$ and filtered. The residue was converted into calcium clay by leaching with calcium chloride, washed, dried and weighed. The weight of residue multiplied by 250 gave the amount of clay dispersed from 100 gms. of Ca-soil obtained by the treatment with carbonates of alkali metals. If this weight be denoted by C', the 'dispersion coefficient' D is given by:

$$D = \frac{C'}{C} \times 100,$$

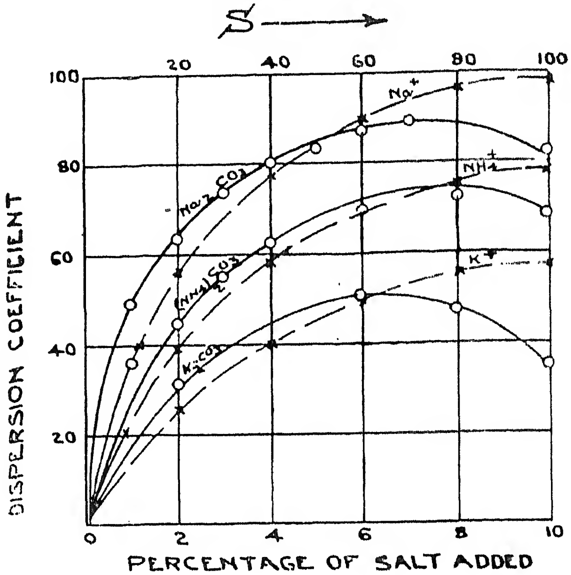
where C is the clay content of the original Ca-clay.

The 'dispersion coefficients' as found by adding different quantities of the carbonates of the alkali metals are plotted and full line curves drawn through them.

In the experiments described above, the dispersion was affected by the presence of excess free salts. Experiments were, therefore, repeated by employing mixtures of pure calcium and alkali soils in suitable proportions. It was found that in these experiments the values of D were related to S, the per cent. of alkali clay by a power relation of type

$$D = mS^k \quad (m \text{ and } k \text{ being constants}) \qquad (1)$$

The variation of 'D' with 'S' is shown by broken lines in the graph. The resemblance between the initial parts of the two sets of curves indicates that the dispersion of soil colloids produced by shaking Ca-soil with the carbonates of alkali metals is due to the gradual replacement of exchangeable calcium by alkali cation. But as the concentration of the free



salt increases in the dispersion medium the alkali cations tend to coagulate the soil by compressing the double layer surrounding the dispersed particles.[2] This is why continuous curves are characterised by definite maxima.

The broken lines in the graph refer to the 'oriented dispersion' of clay particles a term introduced by Marshall[3] for the stability of colloidal suspension due to the modification of the double layer on account of base exchange. It is clear from these curves that the effect of the three ions on the 'oriented dispersion' of clay particles is in the order:

$$Na^+ > NH_4^+ > K^+$$

which is the same as the order of impermeability.[4]

Chemistry Department,
Lucknow University,
Lucknow, K. P. SHUKLA.
August 11, 1943.

1. Shukla and Nayar, *Curr. Sci.*, **10**, 4, 201. 2. Hauser and Hirshon, *J. Phy. Chem.*, 1939, **43**, 1015. 3. Marshall, *J. Soc. Chem. Ind.*, 1939, **50**, 457T. 4. Nayar and Shukla, *Curr. Sci.*, **12**, 156.

* This work has been carried out under the auspices of the Irrigation Department (Research Section), P.W.D., U.P.

NUTRITIONAL REQUIREMENTS OF *L. BULGARICUS*, *L. ACIDOPHILUS* AND *STREPTOCOCCUS LACTIS*

DURING recent years microbiological methods have come into prominence in the estimation of vitamins of the B group. These methods are simple, rapidly reproducible and require only minute amounts of test materials for assay

purposes. The most commonly used organisms are the lactic acid bacteria. The nutritional requirements of certain strains have been studied by various workers.[1-9] The present investigation relates to the study of the nutritional requirements of three strains of lactic acid bacteria, namely, *L. bulgaricus, L. acidophilus* and *Streptococcus lactis,* which hitherto have not received much attention.

The basal medium for these studies contained alkali-treated photolysed peptone, casein hydrolysate, hydrolysed nucleic acid (as a source of purine and pyrimidine bases), cystine, glucose and sodium acetate. The different vitamin solutions used were prepared from crystalline materials, except biotin, which was prepared in the laboratory according to the method of Snell and Wright.[10] The basal medium was brought to pH 6·8, 5 c.c. were added to each tube along with 1 $\mu g.$ of each of the different vitamins, and the volume was made upto 10 c.c. After sterilization for 15 minutes at 15 lbs. pressure the tubes were inoculated with washed suspensions of the cultures, incubated at 37° C. for 72 hours and the amount of lactic acid producd was determined by titration with 0·1 N sodium hydroxide. The results are presented in Table I.

TABLE I

	Cc. O.I.N. lactic acid produced per 10 c.c. medium		
	Streptococcus lactis	*L. bulgaricus*	*L. acidophilus*
1. Medium (M) + no vitamins	1·2	0·4	2·0
2. M + vits. B_1, riboflavin (r), B_6, nicotinic acid (N.A.), pantothenic acid (P.A.) and biotin	5·0	9·5	9·4
3. M + vits. B_1, r, B_6, P.A. and biotin	4·9	9·4	9·4
4. M + vits. B_1, r, P.A., N.A. and biotin	5·0	9·3	9·7
5. M + vits. B_1, r, B_6, N.A. and biotin	1·4	0·4	2·3
6. M + vits. B_1, r, B_6, N.A. and P.A.	5·1	9·4	9·4
7. M + vits. r, B_6, N.A., P.A. and biotin	5·3	9·5	9·6
8. M + vits. B_1, B_6, N.A., P.A. and biotin	2·1	1·7	2·3

It is clear from the above table that the three strains of lactic acid bacteria used in this investigation require only pantothenic acid and riboflavin for growth. Snell[11] reported that vitamin B_6 is required by *Streptococcus lactis* R. We have, however, been unable to detect any stimulating action of this vitamin on our strain.

Landy *et al.*[2,13] in their investigation on the relation between avidin and the biotin requirements of, and acid synthesis in, micro-organisms, observed that the growth of organisms which required biotin in the culture medium was inhibited by avidin, whereas avidin had no effect on organisms capable of synthesising biotin. In view of these observations, the effect of avidin on these three strains was investigated. Avidin was prepared and tested as recommended by Eakin *et al.*[14] The results are incorporated in Table II.

TABLE II

Inactivation of Biotin by Avidin

	Cc. O.I.N. lactic acid produced per 10 c.c. medium					
	Streptococcus lactis		*L. bulgaricus*		*L. acidophilus*	
	Unheated	Heated	Unheated	Heated	Unheated	Heated
1. Medium (M) + vits. B_1 riboflavin (r), B_6, P.A. N.A. and biotin	—	5·2	—	9·5	—	9·4
2. M + vits. B_1, r, B_6, P.A. and N.A.	—	5 2	—	9·5	—	9·5
3. M + vits. B_1, r, B_6, P.A., N.A. and biotin + avidin	2·0	5·2	0·8	9·5	2·1	9·5
4. M + vits. B_1, r, B_6, P.A. and N.A. + avidin	1·4	5·2	0·6	9·5	1·4	9·5

The results show that *L. bulgaricus, L. acidophilus* and *streptococcus lactis* require biotin and that the basal medium contained enough biotin to promote growth of these organisms.

Attempts are now being made to estimate pantothenic acid and riboflavin employing one of these strains, particularly *L. bulgaricus,* since this organism gave the lowest blank and highest titration values.

Our thanks are due to The National Collection of Type Cultures, India, Indian Institute of Science, Bangalore, from whom the cultures used in this investigation were obtained.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor, KAMALA BHAGVAT.
February 8, 1944. NIRANJAN SINGH SEKHON.

1. Orla-Jansen, Otte and Snog-Kjaer, *Zbl. Backt.*, 1936, **94**, 434, 452. 2. Snell, Strong and Peterson, *Biochem. J.*, 1937, **31**, 1789. 3. Snell, Tatum and Peterson, *J. Bact.*, 1937, **33**, 207. 4. Wood, Anderson and Wortman, *Proc. Soc. Expl. Biol.*, N. Y., 1937, **36**, 217. 5. Snell, Strong and Peterson, *J. Amer. Chem. Soc.*, 1938, **60**, 2825. 6. Snell and Strong, *J. Biol. Chem.*, 1938, **123**, **112**. 7. Moller, *Z. Physiol. Chem.*, 1938, **254**, 285. 8. Snell, Strong and Peterson, *J. Bact.*, 1939, **38**, 293. 9. —, *Ibid.*, 1940, **39**, 273. 10. Snell and Wright, *J. Biol. Chem.*, 1941, **139**, 675. 11. Snell, *J. Bact.*, 1943, **45**, 199. 12. Landy, Dicken, Bicking and Mitchell, *J. Bact.*, 1942, **43**, 5. 13. Landy and Dicken, *Proc. Soc. Expl. Biol. and Med.*, **46**, 449. 14. Eakin, Snell and Williams, *J. Biol. Chem.*, 1941, **140**, 535.

EFFECT OF VANADIUM ON YEAST CELLS

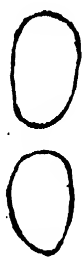
It is generally known that the Saccharomycetes sporulate only under certain specific conditions. Henrici[1] gives details of the conditions under which the different species and strains of Saccharomycetes can be expected to form ascospores and also adds, "Spore formation with yeasts is always uncertain".

In an attempt to analyse the factors involved in sporulation, experiments were made to find if any 'trace elements' were involved. Trials were made on the effect of traces of vanadium pentoxide in the culture media in which the yeasts were grown. The experiments were made with three pure strains of *Saccharomyces cerevisiæ* isolated from Brewers' yeast.

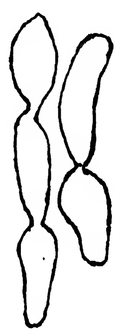
The few experiments conducted gave no decisive result. Results varied with the modes of application, temperatures of cultivation and strains of the yeast. Generally, concentration of one part in one thousand of vanadium pentoxide inhibited sporulation and that of one part in two thousand favoured sporulation.

The vanadium present in the medium in the above concentrations had other effects also.

The vegetative cells of *S. cerevisiæ* became elongated, becoming ellipsoidal, club-shaped or filamentous, in the course of a week in wort-agar slants. This is illustrated by the comparison of Figs. 1*a* and 1*b*. The main vacuole



1*a*
Normal cells



1*b*
V. treated cells

2*a*
Normal cells

2*b*
V. treated cells

or the 'volutin body' developed earlier and attained greater size than in untreated cultures. The structure of the fat granules in the cells was altered. These bodies arise as small refractile granules in three-day-old wort-agar slants, in both treated and untreated cultures. In normal cultures these bodies later coalesce and occupy the central space in majority of the old cells. In Vanadianised cultures these bodies never coalesce, but become distributed along the periphery of the cells. This is illustrated by Figs. 2*a* and 2*b*. In old cultures the vanadianised cultures take up a dark-brown colour, contrasting with pale yellow of untreated cultures. Vanadium favours the formation of vegetative spores or 'Dauer-Zellen'. Such spores are formed in most old cultures and are considered comparable to chlamydospores (Guilliermond[2]). Those spores formed in the presence of vanadium have fat granules distributed on the cell-wall. They germinate freely, after a slight delay, in wort-agar slants.

All these effects were quantitative and not qualitative. The effect lasts only as long as the vanadium is present in the environment, and the cells revert to normal in normal wort.

Section of Fermentation Technology,
Indian Institute of Science,
Bangalore, S. Sampath.
February 2, 1944.

1. Arthur T. Henrici, "Molds, Yeasts and Actinomycetes," New York, 1930. 2. Guilliermond, "The Yeasts," Transl. by F. W. Tanner, New York, 1920.

CATALYSIS OF THE REACTION BETWEEN DICHROMATE AND AROMATIC AMINES BY THE OXALATE ION

It has been previously reported that oxalate catalyses the reaction between dichromate and hydriodic acid[1] and dichromate and hydrobromic acid.[2] We have now found that oxalate markedly accelerates the reaction of a number of aromatic amines with dichromate in the presence of dilute sulphuric acid. The phenomenon has been studied by noting the time required for the appearance of the characteristic colour on reaction with dichromate in the presence and absence of oxalate. For example, about 25 ml. of a very dilute solution of potassium dichromate (N/2500) was taken in a clean beaker and 0·3 ml. of a 0·01 per cent. solution of diphenylamine in concentrated sulphuric acid was stirred in quickly; a stop-watch was started simultaneously and the time required for the appearance of the blue violet colour was noted. In the absence of oxalate it took five minutes for the blue violet colour to appear, whereas when 1 ml. of N/5 sodium oxalate was added (under otherwise identical conditions) the blue violet colour was immediately produced. The results with the amines experimented with are recorded in Table I.

All substances under test are dissolved in concentrated sulphuric acid, and a known volume of the solution treated with 1 c.c. of a decinormal solution of potassium dichromate and a requisite amount of water to bring up the volume of the reaction mixture to a total of 25 c.c.

TABLE I

Substance	Quantity and concentration of the test solution	Observations	
		Without oxalate	With oxalate (overall concentration 0·02 N)
Aniline	0·5 ml. of a 0·1% solution	Green precipitate in 20 minutes	Green precipitate in 5 minutes
o–toluidine	0·5 ml. of a 5% solution	No colour change even in 20 minutes	Immediate orange brown colour turning grey in five minutes
p–toluidine	2·0 ml. of a 0·1% solution	No colour change even in 15 minutes	Red brown colour in 2 minutes
m–toluidine	0·5 ml. of a 5% solution	No colour change even in 30 minutes	Ruby Red colour in one and half minutes
α–naphthylamine	2·0 ml. of a 0·1% solution	Brown colour in 10 minutes	Deep Ruby colour almost immediately
Diphenylamine	0·3 ml. of a 0·01% solution	Blue violet in 5 minutes	Blue violet almost immediately oxalate concn. (N/125)
Dimethylaniline	0·1 ml. of a 5% solution	No colour change even in 20 minutes	Orange colour in half a minute
Tetramethyl diamido-diphenyl methane	0·5 ml. of a 0·1% solution	No colour change even in 30 minutes	Orange colour immediately

Chemical Laboratories,
Andhra University,
December 23, 1943.

C. R. VISVANADHAM.
G. GOPALA RAO.

1 C. R. Viswanadham and G. Gopala Rao, *Curr. Sci.* 1942, **11**, 102. 2. —, *Ibid.*, 1943, **12**, 186.

BALUCHISTAN SULPHUR FOR JOWAR SMUT

SULPHUR is one of the most widely used fungicides against crop diseases. Its supply, which is mainly from abroad, has become extremely difficult due to war and this is working as a great handicap against its free use as a fungicide. Fortunately India possesses a big store of it in the Baluchistan sulphur mines, where it occurs in crude form in lumps and has to be ground finely before use. Its purity has been found to be about 56 per cent. Its use as a seed-dressing against jowar smut [*Sphacelotheca sorghi.* (Link) Clinton] has been found to be very efficacious as seen from the details of an experiment done at the Gwalior Central Farm in 1943.

Four seers (8 lbs.) of jowar seed were dusted with the smut spores and well mixed in by rubbing the grains between the hands. They were then divided into three equal lots. One lot was treated with finely ground Baluchistan sulphur which had passed through a sieve a little finer than 100-mesh, the second was treated with commercial flowers of sulphur of 200-mesh fineness; and the third was used as a control. The quantity of sulphur used for each lot of seed weighing 1½ seers was 5 grams, *i.e.*, the rate of dressing was half an ounce (one and a quarter tolas) per four seers. Each lot was sown separately and the infection noted when the crop matured.

Treatment	Sound heads	Smutted heads
Seed infected with spores, then treated with Baluchistan sulphur	7489	Nil
Seed infected with spores, then with pure sulphur	8462	Nil
Seed infected with spores alone, control	6624	2079

It will be noted that Baluchistan sulphur, even of 56 per cent. purity, is as effective as commercial flowers of sulphur of 99 per cent. purity in controlling jowar smut.

Regarding its supply, one should write to the Director, Chemical Directorate, Directorate-General of Supply, Sahajahan Road, New Delhi. It is hoped that other workers will give their experiences with Baluchistan sulphur.

I am grateful to Dr. G. Watts Padwick, Imperial Mycologist, for giving me the information regarding the Baluchistan sulphur.

Govt. Central Farm,
Gwalior Government,
Gwalior,
December 16, 1943.

G. S. KULKARNI.

KULKARNI'S NOTE ON BALUCHISTAN SULPHUR

WE are grateful to Mr. G. S. Kulkarni for having been good enough to show us the draft of his note on Baluchistan sulphur. At the Imperial Agricultural Research Institute we have worked with this material for three years but unfortunately in some of our experiments infection was low in the controls. In 1942-43 we experimented with covered smut of barley by treating seed with Baluchistan sulphur of 75 per cent. purity powdered and passed through a 100-mesh sieve. The seed was sown at Karnal and Delhi in replicated plots, and sulphur compared with other treatments. All were used at the dosage 1 : 250 by weight.

The results indicated that Baluchistan sulphur dust is suitable and at least equal to pure sulphur.

As a result of this success, we decided in 1943 to treat 12·5 acres of jowar with the

Baluchistan sulphur dust and leave 11·5 acres untreated.

Treatment	Percentage of smut	
	Delhi	Karnal
Control	1·20	1·44
Pure sulphur	0·08	0·10
Formalin dust (6 per cent. formalin on charcoal dust)	0·00	0·04
Agrosan G.	0·01	0·08
Baluchistan sulphur ..	0·05	0·08

Two different lots of seed were used, one from Rohtak and the other from Karnal, both naturally infested with grain smut spores. The percentages of grain smut in the resulting crops were as follows:

Area in acres	Seed	Treatment	Percentage grain smut
1	Rohtak	Treated	Nil
11·5	Karnal	,,	Nil
11·0	Rohtak	Untreated	9·8
0·5	Karnal	,,	2·1

It will be noted that our sulphur was hand-picked before grinding and so brought up to 75 per cent. sulphur. It is of great interest to us that Kulkarni has obtained comparable results with the unpicked material.

Mycology Section,
Imperial Agricultural Research Institute,
New Delhi,
January 14, 1944.

G. WATTS PADWICK.
B. B. MUNDKUR.

NEOVOSSIA INDICA IN CULTURE

DURING the course of an investigation on the germination of the chlamydospores of *Neovossia indica* (Mitra) Mundkur, the slides on which they were germinating were inverted over the surface of potato agar in petri-dishes and the sporidia allowed to drop on it. Every precaution to avoid contamination was taken. The dishes were incubated at 15° C. for seven days, at the end of which period small white colonies became manifest in most of the dishes. The colonies consisted of thick mats of much branched mycelium and numerous secondary sporidia.

On transfers being made, it was noted that the organism can grow well on potato dextrose agar and in three per cent. malt extract solution. The colonies are white, powdery, brittle, crustaceous, umbonate, with dendritic margins, and spread rather slowly. A temperature of 18° C. has been found to be suitable for their growth. The mycelium coils in a peculiar manner, branching, rebranching and producing secondary sporidia, singly and at intervals. The opposite sides of the test tubes or the upper lids of the petri-dishes, as the case may be, get coated with secondary sporidia which are violently discharged. The secondary sporidia and the mycelium appear to be entirely monocaryotic.

Further cultural studies on the behaviour of these isolations and their ability to infect the host are in progress.

Mycology Section,
Imperial Agricultural Research Institute,
New Delhi,
January 20, 1944.

C. S. RAMAMOORTHY.
B. B. MUNDKUR.

DEVELOPMENT OF THE EMBRYO-SAC OF *ZIZYPHUS JUJUBA* LAMK.

THE development of the embryo-sac of *Zizyphus sativa* was investigated by Chiarugi (1930) and he found an *Allium*-type of embryo-sac in this species. Srinivasachar (1940), on the other hand, has recently reported the *Normal*-type of embryo-sac in *Z. Jujuba* and *J. œnoplia.* I have reinvestigated the embryo-sac of *Z. Jujuba* and find myself unable to agree with the observations and conclusions of Srinivasachar. Even after examining numerous preparations, I have been unable to observe the formation of a tetrad of megaspores from the megaspore-mother-cell in any case. The megaspore-mother-cell gives rise only to a dyad. Both the dyad cells generally become binucleate, but no cell-walls are laid between these nuclei. The nuclei of the chalazal dyad cell then undergo two more mitotic divisions and form an eight-nucleate embryo-sac. The development of the embryo-sac in *Z. Jujuba*, therefore, is clearly of the *Allium*-type, as reported previously by Chiarugi (1930) in *Z. sativa.*

Another interesting feature of megasporogenesis in *Zizyphus Jujuba* is the very frequent occurrence of multiple embryo-sacs. As many as six or seven embryo-sacs have been observed in one ovule. These generally result from the simultaneous development of several megaspore-mother-cells, but sometimes multiple embryo-sacs also arise from the development of both the dyad cells derived from a single megaspore-mother-cell.

Thanks are due to Dr. A. C. Joshi for his kind interest.

T. N. J. College,
Bhagalpur,
December 20, 1943.

L. B. KAJALE.

1. Chiarugi, A., *Nuovo giorn bot. Ital.*, N. S., 1930, **37**, 287–312. 2. Srinivasachar, D., *Proc. Ind. Acad. Sci.*, B, 1940, **11**, 107–16.

A NOTE ON THE STRUCTURE OF THE PETIOLE OF AN ANOMALOUS LEAF OF *HELIANTHUS ANNUUS*, LINN. (COMPOSITÆ)

TRANSVERSE sections of the petiole of an abnormal bilobed leaf of *Helianthus annuus* Linn. showed in addition to the normal vascular bundles in an arc, several internal bundles in line with some of the normal ones. In general outline the petiole is dorsoventrally symmetrical at the base, but it becomes gradually radially symmetrical as it reaches the lamina region. Resin ducts are present in the parenchymatous cortex of the abaxial side only. They are arranged in the form of an arc. According to

Haberlandt,[1] in the petiole of Sunflower every vascular bundle is subtended by crescentic group of oil passages, both on its inner and on its outer side. In the present case some of the vascular bundles of the outer arc only are subtended by resin ducts on their outer side only. Structurally the resin ducts consist of seven to eleven secretory cells and one sheathing layer. The number of resin ducts vary from 13 to 19. There is no visible endodermis and pericycle.

There is the usual arc of collateral bundles. Some of them have internal bundles of various ages and sizes. The number of the internal bundles, in association with a normal bundle, may be more than one in some cases. The internal bundles arise from pith cells situated opposite to the protoxylem of the normal bundles and develop into reversed collateral bundles, quite independent of the outer normal bundles. They appear to develop after the normal bundles. They sometimes arise opposite to the medullary rays, or in the medullary rays of the normal arc. In the medullary bundles the position of the xylem and phlœm is not changed as in the internal bundle. These internal bundles are also collateral and show inverse orientation of the xylem and phlœm but some are composed of phlœm or xylem only. The direction in which the protoxylem elements point and the amount of xylem and phlœm formed, vary in different internal bundles. Occasionally two bundles are found touching each other by their xylem or phlœm faces. This gives an impression of a normal bundle with an inversely oriented internal bundle. This may be due to branching of individual bundles and to anastomoses taking place between bundles. The single bundle gradually divides itself into two which then rotate in such a way as to lie opposite to each other and for a short distance touch by their xylem or phlœm faces before becoming entirely separated.

Two types of anomaly in the structure of petiole in general are recorded by Solereder.[2] The occurrence of "rayed bundles" is one; while the other is "true concentric or hemiconcentric bundles". The Compositæ represent one of the natural orders, many members of which exhibit internal or medullary phlœm in their stems. Worsdell[3] in his study of origin and meaning of medullary (intra-xylary) phlœm in stems of dicotyledons has investigated many Comopositæ plants. He found complete absence of medullary strands in the petiole of seven species of Rudbeckia and of Dahlia. Of the tribe Helianthoideæ only in the petiole of *Echinacea purpurea* Moench., he observed the scattered disposition of the bundles. According to Thoday,[4] "in the petiole of a large leaf of Sunflower, there are a number of small bundles, besides the three principal ones. These small bundles appear to anastomose in rather intricate fashion and one or two large ones unite with two lateral bundles. In the base the remainder cluster round the principal bundles as they diverge. Many of the smallest bundles consist, even in the case of a matured leaf, of phlœm only and in others the xylem dies out in the normal region."

The phylogenetic or physiological significance of the internal bundles has been discussed by several authors as Worsdell,[3] Maheshwari and Singh,[5] Wurke,[6] Alexandrov and Alexandrova,[7] and Hartwich.[8] According to Worsdell[3] they represent a vestigial structure, the remnant of a former system. Maheshwari and Singh[5] and Wurke[6] are of opinion that they are of an advanced character, the species with higher chromosomes being generally found to possess them and those with the lower numbers lacking them. Alexandrov and Alexandrova[7] and Hartwich[8] also regard them as derived. It may be quite possible that the extra bundles are developed in response to nutritive demand.

Bahauddin College,
Junagadh, G. A. KAPADIA.
September 21, 1943.

1. Heberlandt, G., *Physiological Plant Anatomy*, 1928, p. 525 (Macmillan & Co., London). 2. Solereder, H., *Systematic Anatomy of the Dicotyledons*, 1908, **1 & 2.** 3. Worsdell, W. C., "The Origin and Meaning of Medullary (Intra-xylary) Phloem in the Stem of Dicotyledons. II. Compositæ," *Ann. of Bot.*, 1919, **33,** 421. 4 Thoday, D., "On the Organization of Growth and Differentiation in the Stem of Sunflower," *Ibid.*, 1922, **36,** 489. 5. Maheshwari, P., and Singh, B., "On the Internal Bundles in the Stem of *Rumex patientia*, L.," *Proc. Ind. Acad. Sci.*, B., 1942, **15,** No. 3, 153–57. 6. Wurke, H. (cited by Maheshwari and Singh), 1933. 7. Alexandrov, W. G., and Alexandrova, O. G., *Ibid.*, 1926. 8. Hartwich, W., *Ibid.*, 1936.

A PODOSTEMAD FROM KUMAON (CENTRAL HIMALAYAS)

MEMBERS of the family Podostemonaceæ have been recorded in this country from South India, Assam, Eastern Himalayas (*cf.* Hooker[1] and Willis[2]) and recently Haines[3] has described one species (*Lawia zeylanica*) from Orissa. In the Himalayas, there are no records of Podostemonaceæ west of Darjeeling. The collection of a podostemad from Kumaon is thus of interest in connection with the geographical distribution of the family.

The plant was found growing closely attached to large stones in the bed of the Kosi river at Chananda (29·46 N. and 79·38 E.), about 16 miles from Almora and 4,500 feet above the sea-level, in the months of August and September. The exact spot can be located by its situation opposite to the Gandhi Ashram of Chananda. On comparison with the other members of the family, it is seen that this podostemad belongs to the genus *Zeylanidium* Tul., described as a subgenus of *Hydrobryum* Endl. by Willis[2] in his account of the Podostemonaceæ of India and Ceylon. The genus *Zeylanidium* at present includes three species, *Z. olivaceum* (Gardn.) Engl., *Z. lichenoides* (Kurz) Engl. and *Z. Johnsonii* (Wight) Engl. The present material from Kumaon does not appear to agree with any one of these and is to be regarded as a new species.

Rae Bareili, and
Benares Hindu University, M. S. RANDHAWA.
January 15, 1944. A. C. JOSHI.

1. Hooker, J. D., *Flora of British India*, 1886, **5.** 2. Willis, J. C., "A Revision of the Podostemaceæ of India and Ceylon", *Ann. Roy. Bot. Gard. Perad.*, 1902, **1,** 181–250. 3. Haines, H. H., *Botany of Bihar and Orissa*, 1924, **5.**

A NEW COCCIDIAN FROM THE INTESTINE OF THE FISH *NOTOPTERUS NOTOPTERUS* (PALLAS)

On August 5, 1943, Mr. S. P. Basu, Research Assistant of I.C.A.R. Fishery Scheme, Calcutta University, placed at the disposal of the authors some coccidian oöcysts obtained from the intestine of the fish *Notopterus notopterus* (Pallas), purchased from one of the local markets. The collection of oöcysts included few immature and a large number of mature forms which were identified as belonging to the genus *Eimera*. The few species of this genus that have so far been recorded from Indian fishes are *E. southwelli* Halawani[1] (1930), *E. harpodoni* Setna and Bana[2] (1935) and several unidentified ones by the last named authors. The parasite found by us appears to be new to science and is herein described under the proposed name of *Eimera notopteri* sp. n.

Specific diagnosis: Both the mature and the immature oöcysts are irregular in shape and measure $24 \cdot 2\,\mu \times 22\,\mu$. The unsegmented zygote within an immature oöcyst (Fig. 1) is spherical in shape with highly granular cytoplasm and contains several refringent globules. The oöcysts possess a double-layered envelop and are without any micropyle or oöcystic residuum.

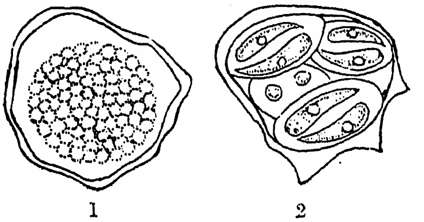


FIG. 1. An immeture oöcyst × 1660
FIG. 2. A fresh mature oöcyst × 1660

The sporocysts (Fig. 2) are oval in shape with both the ends pointed and measure $11\,\mu \times 6 \cdot 6\,\mu$. They are without any refractile knob or residual mass. The sporozoites are elongated bodies with the anterior end pointed and the posterior rounded. The nucleus is situated at the centre of the sporozoites.

Affinities: Of the known species of *Eimeria* from the cold-blooded vertebrates [*vide* Levine and Becker[3] (1933)], *E. notopteri* sp. n. shows close affinity to *E. ranæ* Dobell[4] (1908) in shape and size but differs from the latter in the absence of oöcystic and sporocystic residuum as well as in the shape of the sporocysts.

MUKUNDAMURARI CHAKRAVARTY.
AMIYA BHUSAN KAR.
Department of Zoology,
University of Calcutta,
February 4, 1944.

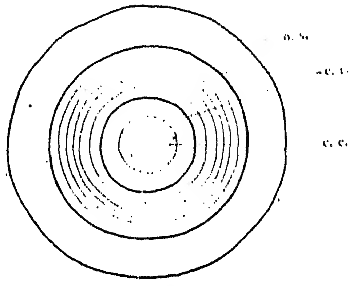
1. Halawani, A. *Ann. Trop. Med. Parasit.*, 1930*a*, **24**, 1–3. 2. Setna, S. B., and Bana, R. H., *J. Roy. Micr. Soc.*, 1935, **55**, 165–69. 3. Levine, N. D., and Becker, E. R., *Iowa. State Coll. J. Sci.*, 1933, **8**, 83–106. 4. Dobell, C., *Proc. Camb. Phil. Soc.*, 1908, **14**, 428.

THE OCCURRENCE OF THE CRYSTALLINE STYLE IN *LAMELLIDENS MARGINALIS* (LAMARCK)

The common fresh-water mussel *Lamellidens marginalis* is dissected as a type of the Mollusca in most of the zoological laboratories of India, and it is, therefore, necessary to know all the facts about its anatomy. Although the anatomy of this form has been studied by Ghosh,[1] Prashad,[2] and Bloomer,[3] none of these authors seems to have noticed the *crystalline style* within the alimentary canal of this mussel. While working on this type, I found a well-formed *crystalline style*—a structure not commonly demonstrated to students in our laboratories.

FIG. 1

FIG. 1. Crystalline Style of *L. marginalis* *h.* head end; *c.c.*—central core; *t.* tail end (× cir. 2½)



2

FIG. 2

A transverse section of a crystalline style. *o, s.*, outer sheath; *c. r.*, concentric rings formed from the outer part of the central core; *c. c.*, unstratified part of the central core. (× cir. 112).

The crystalline style of *L. marginalis* is a transparent, more or less elongated, rod-like structure, about 3 to 4·4 cms. in length, and about ·4 to ·75 mm. in diameter in an animal measuring 8 to 9·5 cms. in length. According to Biedermann[4] the crystalline style of *Anodonta* is 7 to 8 cms. long, while Gutheil[5] gives the length as 6 to 7 cms. in an animal 13 to 14 cms. long. Mitra,[6] while describing the crystalline style of *Anodon*, states that it is three-fourths as long as the animal itself.

The style of *L. marginalis* (Fig. 1) is thicker at its anterior than at its posterior end. The anterior end (about 2 mm. in length) lies within the stomach and is bent on itself, while the remainder of the style is contained within

a groove of the first part of the intestine. The bent condition of the anterior end is not shown in the diagrams of the style of *Anodonta grandis* and *Anodon* made by Nelson[7] and Mitra. Since the groove of the intestine in which the style is lodged is an open groove and not a closed "sac", I consider that it is proper to call it "style groove" rather than "style sac".

A freshly formed crystalline style consists of a central core surrounded by a homogeneous sheath, the core being about three-fourths the diameter of the style. But as the style grows, the outer part of the core develops several ring-like concentric layers, leaving only a small, soft, unstratified part in the centre (Fig. 2).

In mussels which have been out of the river for several hours the crystalline style disappears, but when these very specimens are again kept in an aquarium in the laboratory, it is found that a very long and stout style generally reappears.

Zoology Department,
Lucknow University,
December 3, 1943. PREM VATI GUPTA.

1. Ghosh, E. N., *Rec. Ind. Mus.*, 1918. 2. Prashad, B., *Ibid.*, 1918. 3. Bloomer, H. H., *Proc. Malacol Soc. Lond.*, 1931. 4. Biedermann, W., *Handbuch d. vergl. Physiol.*, Band. II., Jena, 1910. 5. Gutheil, Fritz., *Zeit. f. wiss. Zool.*, 1912, Bd. 99. 6. Mitra, S. B., *Q.J.M.S.*, 1901, **44.** 7. Nelson, T. C., *Jour. Morph.*, 1918, **31.**

AN IMPROVED TYPE OF BOTTLE SILT SAMPLER

A BOTTLE SILT SAMPLER was designed in 1934 for collecting suspended silt in channels to study the chief quality characteristics of the transported material, particularly the silt charge and the silt grade, in connection with the Lacey Formulæ for Regime Flow of Channels. But the Bottle silt sampler, being an ordinary container type, has to be opened at the requisite depth of sampling for the minimum time to fill; otherwise the silt concentration increases with the length of time for which it remains open under submergence after it is full.

To overcome this difficulty, the Binkley and Uppal silt samplers were subsequently designed, which consist of hollow metallic cylinders with axis parallel to the flow of stream at the time of sampling. In the case of these samplers, the need of measuring filling time does not arise as the silt-laden water is in continuous flow through them and as soon as the requisite depth of sampling is attained, silt sample is trapped by closing both the ends simultaneously.

But comparatively, the Bottle silt sampler has proved to be superior on account of its handy size, simple construction and ease of working in actual practice. It was, however, necessary to provide it with an *infallible device* to know when it gets filled so that it may be closed instantaneously after it is full.

With this object in view, the Bottle sampler has been fitted in its neck with a make-and-break circuit device (*vide* Fig. 1). As soon as it gets filled, a cork float, carrying a copper plate on its top, rises and completes circuit by touching two copper screw poles, which are connected to an electric bell and dry cells in the observer's boat. Consequently the bell rings and mouth of the Bottle sampler is closed by the observer instantaneously by releasing a spring stopper, which also depresses

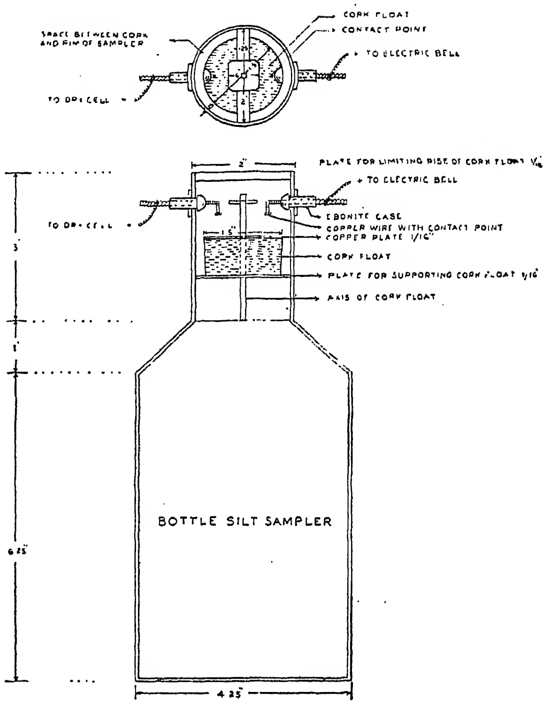


FIG. 1

the float slightly to break the circuit. The sampler is then withdrawn for emptying its contents.

The device has been tried and found to be efficient and useful in the work of silt sampling.

Irrigation Res. Lab.,
Sind P. W. Dept.,
Karachi,
December 23, 1943.
K. K. FRAMJI.
G. S. RAISINGHANI.

Fortier, S., and Blaney, H. F., *Silt in the Colorado River and its Relation to Irrigation*, 1928. Lacey, Gerald, *Stable Channels in Alluvium*, 1930. Taylor, McKenzie, *Punjab Practices in Silt Observations*, 1936; *Bull. No. 13 of the Central Board of Irrigation*, **1939**. Raisinghani, G. S., *A Note on an Improved Type of Bottle Silt Sampler*, 1940; *Annual Report of the Work done in the Development and Research Division for the Year ending May 1942*. Thomas, A., D. O. No. 5594-Jr. 115, dated 28th September 1942 to Mr. Framji, 1942. Framji, K. K., D. O. No. D-4, dated 28th November 1942 to Mr. Thomas, 1942.

REVIEWS

A Treatise on Physical Chemistry. Edited by Hugh S. Taylor and Samuel Glasstone. Volume I. Atomistics and Thermodynamics. (Macmillan and Co., Ltd.) Pp. 679. Price 42*sh*.

The first and second editions of this well-known book were very well received and have found a place in the shelves of all serious students of physical chemistry. The third edition has been conceived on a more ambitious scale. Prof. Taylor has secured in this enterprise the collaboration of Prof. Samuel Glasstone as a co-editor and a band of well-known specialists for writing out selected chapters of the treatise which is now intended to be published in five volumes. In the inter-war period, the science of physical chemistry has made remarkable progress. And the editors have rightly felt that there is need for a treatise which will "set forth adequately all the great advances in the science, define the present status of the subject and present to the student the accumulated experience of his predecessors in the work, so that he may go forward to the new field as yet unexplored". In this aim the authors have been eminently successful. The first volume consists of four chapters—chapter I on the atomic concept of matter, and chapter III on the first and second laws of thermodynamics, have been contributed by Professors Taylor and Jones, chapter II on the quantum theory of atomic spectra and atomic structure by Dushman and chapter IV on the third law of thermodynamics and statistical mechanics by Professor Aston.

Each chapter is, as it should be, a self-contained monograph in itself. This has led to some amount of duplication; for example, pages 401-405 of chapter II, dealing with magnetic properties of atoms and ions in relation to spectral type, and pages 627-632 in chapter IV, dealing with magnetic cooling, have much material in common. This decision of the editors not to completely eliminate overlapping in order that the narrative may be continuous and coherent in each chapter will, however, be welcomed by the readers.

The first chapter gives a rapid survey of atomic concepts, periodic classification of elements, properties of the nucleus and the electron, disintegration in radio-active series, and then passes on to a concise but up-to-date treatment of the subject of isotopes and nuclear reactions. A table giving nuclear masses of elements from hydrogen to argon and their isotopes in terms of $0 = 16$, reveals the wonderful accuracy of modern physico-chemical measurements. The newer methods of separation of isotopes by electrolysis and thermal diffusion have been deservedly given special prominence. Almost half the chapter has been devoted to the description of nuclear transformations, and in three informative tables has been summarised our present knowledge of (*a*) type reactions in nuclear transformations, (*b*) stable isotopes of elements and their abundances and (*c*) the essential facts of induced radioactivity, *e.g.*, methods of production of each induced radio-active element, its principal type of radiation, the energy of such radiation and its half life. Such extensive data, it is hoped, will soon be correlated to give us a consistent theory of the mechanism of nuclear processes. The chapter ends with a clear account of the modern work on nuclear fission of uranium into a barium nucleus of mass 139 and a residue of mass ~ 100 and the subsequent decay of these fission products. Linking up the narration, in appropriate places, have been given the history of the discovery of the fundamental particles—electron, positron, proton and neutron, and their properties; the particulate and wave aspects of matter and the interrelation of mass and energy have also been lightly touched upon. One wishes that a more detailed account were given of the production of positron-electron pairs by annihilation of γ-radiation.

Chapter II covers 318 pages and deals with the spectra and structure of atoms. We have now got elegant books on the subject in the English language—*e.g.*, White's *Introduction to Atomic Spectra*, Candler's *Atomic spectra* and the *Vector Model*. The treatment here appeals more to the physical chemist in that many allied topics have been discussed at considerable length, *e.g.*, photo-electric phenomenon, Compton Effect, Raman Effect, ionising potentials of normal and stripped atoms, thermal excitation and ionisation, metastable states of atoms, collisions of the second kind, life-period of excited states, etc. The important work of Bowen, Grotrian and Edlen who traced the origin of nebulium and coronium lines to forbidden transitions of highly stripped light and medium weight atoms deserved mention in this chapter.

The subject of hyperfine structure of spectral lines has received proper attention. The new experimental technique for such studies, based on the atomic beam and molecular beam resonance method has been described and a theoretical exposition given relating the hyperfine structure to the nuclear spin quantum number and the nuclear magnetic moment of the atom. These magnitudes have been tabulated for some 28 atoms and several interesting conclusions drawn. The section concludes with the following observation: "The presence of negative (nuclear) magnetic moments is another fact of interest in any such theory of binding between protons and neutrons. Bethe and Bacher have pointed out certain relations between values of μ and the structure, but a more explicit theory of the nature of the forces between the two elementary particles is required before it will be possible to account quantitatively for the observed values of nuclear moments."

The last section of the chapter deals with the quantum theory of valency. The principles of quantum mechanics enable one to write down equations for any system of nuclei and electrons which would give all information about the stability and structure of such systems. Such equations are, however, capable of only approximate solutions, but the skilful treatment of Heitler, London and Pauling, have provided us with a truer understanding of the valency

rules which the chemists have developed by codification of their experimental observations. Thus the directed covalent bond, the tetrahedral orientation of the valencies of the carbon atom, and the octahedral configuration of cobaltamine complexes find ready explanation in the preference of P orbitals for particular directions, in the hybridisation of s and p orbitals, and in the combination of two d orbitals with s and p. The chapter concludes with a very short section on the concept of resonance energy; in view of the importance which it is rapidly gaining, this subject might have been treated at greater length.

The chapter on the first and second law of thermodynamics brings out the significance of information gained by the increasing accuracy of thermochemical measurements. The investigations of Rossini in the National Bureau of Standards and the compilation by him of the best self-consistent values for the heats of formation of chemical compounds have created a new interest in the subject. The sections on (*a*) partial molal quantities, (*b*) the statistical nature of the second law and (*c*) the correlation of partition function with internal energy, heat capacity, equilibrium constant, free energy and gas pressure, have adequately dealt with the new ideas in the field.

The equilibrium constant of a chemical reaction can be calculated from calorimetric measurements if the entropy change can be evaluated. In his famous Heat Theorem, Nernst assumed that the entropy per gram atom for condensed systems is the same at absolute zero and that rate of variation of heat capacity with temperature in the neighbourhood of absolute zero approached zero asymptotically. The quantum theory and the relation of entropy to probability support this theorem; and the third law states that the entropy of all perfect crystals is zero at the absolute zero, while their heat capacities vary in the way postulated by Nernst. In the fourth chapter, four methods have been described to check the validity of the third law and values of ionic entropies based on this law given in a tabulated form. The classical Maxwell Boltzmann Distribution Law and the quantum modifications introduced by Einstein-Bose and Fermi-Dirac have been fully discussed. Many examples have been given of agreement between entropies of rigid polyatomic molecules calculated from spectroscopic and molecular data with those obtained from calorimetric data down to low temperatures. The modification necessary to account for the behaviour of non-rigid polyatomic molecules are then described and the potentials hindering internal rotation evaluated. The determination of such potentials is shown to be very useful for calculating the equilibrium constants of several technical gas reactions, *e.g.*, the syntheses of methyl alcohol from carbon monoxide and hydrogen or the dehydrogenation of isopropyl alcohol to acetone. The chapter ends with three well-written sections on the calculation of chemical constants, the heat capacity of solids and magnetic cooling at low temperatures. The book is remarkably free from printing mistakes, but one cannot help noticing a mistake in the second vertical column of Table XIX on page 626 where "acoustical C_p Debye" should be acoustical C_v Debye".

The first volume has fulfilled the high expectations which the authors have raised and it is hoped that the succeeding volumes will maintain this high standard. J. C. GHOSH.

Annual Review of Biochemical and Allied Research in India, Vol. XIII for 1942. (Society of Biological Chemists, India, Bangalore), December 1943. Pp. 1-91, with an Author and a Subject Index. Price Rs. 3 or 6*sh*.

This *Annual Review* for 1942, the thirteenth of the series, covers, as usual, the entire field of work carried out in India and by Indians abroad, as could be judged from the numerous sections comprising enzymes, vitamins, general nutrition, human physiology, animal nutrition, protein, fat, carbohydrate and mineral metabolism, pharmacology, human pathology, plant physiology, chemistry of plant products and soils and fertilisers. One misses badly that familiar and important section, microbiology and fermentation. It would be difficult to believe that no work was done in this branch in India during the period under review. Due to war? Perhaps yes, for, the sum-total of work judged from the number of pages making the current review is far less than the collection offered as in 1939 by the Society. Be that as it may, research workers in India, and Indians overseas owe a deep debt of gratitude to the Society of Biological Chemists for bringing out this useful summary of literature year after year.

Now to a little setting of the house in order. A few themes have made their appearance, no doubt differently clothed, each time, in more than one section, while certain sections discuss theses not wholly relevant. Thus it is difficult to appreciate the prominent inclusion of the subject, freezing point as a method of detecting the adulteration of milk, in the chapter on "animal nutrition" whatever the interpretation of the term 'animal'. Perhaps the editors could help in future to remedy these remediable defects, as also endeavour to bring out the review not much long after the close of the year to which the review relates. This would save for the editors some very embarassing situations. How would they relish, for example, reading in the beginning of the year 1944, in the *Annual Review* for 1942, published by them in December 1943, an advertisement forewarning that the *Indian Medical Research Memoirs* volume for 1943 will contain only two instead of the usual four numbers!

S. N.

The Genetics of the Mouse. By Hans Grüneberg. (Cambridge University Press, London), 1943. Pp. xii + 412. Price 30/- net.

The mouse, the familiar rodent, has been the subject of two important scientific monographs in recent years. The staff of the Roscoe B. Jackson Memorial Laboratory have published *Biology of the Laboratory Mouse* dealing on all aspects of the normal mouse. The present volume under review, is the second one on a specialised aspect of the mouse, namely, on its genetics.

The mouse has been a favourite animal for varied biological experimentation for the last many years. The science of genetics has in the mouse an unique experimental animal in that "the main contribution of the study of the mouse to the knowledge of genetics as a whole lies in the field of developmental genetics. The anatomy, embryology, physiology and pathology of the mouse is similar to that of man and in studying aberrations in the mouse, we enjoy the immense advantage of being able to utilise the whole body of knowledge about medicine in the widest sense as an ancillary science: in their turn the inherited variations of the mouse constitute an almost untapped source of information for the numerous questions in physiology and pathology."

Apart from introductory chapters such as on taxonomy, reproduction and growth, etc., the main body of the book is divided into three chapters, namely, the "inherited differences", "chromosomal inheritance", and "induced genetic changes". The book concludes with appendices containing a short chapter on "the genetics of cancer in mice" by Drs. C. C. Little and P. A. Gorec and a short note on "the keeping and breeding of mice for genetical experiments". There is an extensive bibliography on all the subjects dealt with in the book, the total references numbering to more than thousand original papers. There are the usual author and subject indices also. The book is throughout illustrated by 43 text-figures and 14 excellent plates. Considering the present conditions the quality in the get-up of the book is quite good.

The chapter on chromosomal inheritance deals with the linkage relationship of all the known genes. The chief point that is to be noted in this connection is that "at least twelve out of the nineteen autosomes are now labelled with one or more genes" and with more knowledge accumulating this number may be raised shortly to sixteen. The chapter on the inherited differences, by far the biggest in the book, occupying nearly 250 pages, treats exhaustively of the origin, genetics, the phenotypic expression in the individual, and most important of all with the "mechanism of gene action" through the study of the development and patho-physiology of the individual mouse. Within the compass of this chapter no less than 79 "qualitative" differences affecting every conceivable organ of the mouse such as the integument, the endocrines, the sense organs and the brain, the blood-forming organs and the blood, the skeleton, the alimentary tract, the urogenital organs, etc.; and no less than 16 "quantitative" differences, such as serological differences, differences in disease resistance and in behaviour are treated concisely, clearly and most interestingly. From the big array of phenomena, the reviewer finds it difficult to select particular topics. However, the sections dealing with the Piebald Spotting, Pituitary Dwarfism, Psudencephaly, Myelencephalic Blebs, Macrocytic Anæmia, Siderocyte Anæmia, Grey-lethal, the short-tail (Brachyury) series, etc., are only random selections from the book which the reviewer read with extreme interest. Lack of space prohibits anything like an adequately complete review of this extremely important fact-crammed book. But by choosing a typical example, one may attempt to give an idea of the treatment of the subject throughout the book.

Let us consider the gene that brings about the remarkable Myelencephalic Blebs in the embryonic mice inheriting the gene in homozygous condition. The gene is considered under the following sections: origin, genetics, description and embryology. We read under the first section that the gene arose during the course of certain X-ray experiments on a heterozygous stock of mice in Little and Bagg's Laboratory in 1923. But, however, evidences show that this was not a true X-ray mutant, but only that it was already present in the heterozygous stock in a recessive state. On becoming homozygous in an individual it brought about the various eye and foot anomalies. Under the section genetics we read about the intriguing behaviour of the gene during planned breeding tests. One thing is only straightforward in all the variety of genetical data, namely, the recessive nature of the gene when outcrossed to unrelated normal mice. But in back-crosses and F_2 matings we observe the extremely disturbed numbers from those expected on either 1 : 1 or 1 : 3 expectation. Further, we observe the surprising occurrence of a large number of spurious (for, they are only normal overlaps) normals when homozygous recessives are mated *inter se*. Next we read that selection in homozygous lines can bring about remarkable shifts in the percentage of abnormals and in case of selection for foot anomalies the selection not only influences the incidence of the anomalies but also to some extent the localisation of these defects predominantly in the front limbs or in the hind limbs. The last surprise we have as we proceed in our study is that it is possible to select for strains with many eye defects and practically no foot defects, but not *vice versa*. Now, indeed, the genetic and anatomical situation is very complex,—"a task", if one had not the next section to read, "beyond the imagination of most investigators". As a matter of fact, it is almost the rule throughout the book that we get a revealing insight into the purely genetical phenomena only on reading the developmental and patho-physiological aspect of the case. Indeed, this forms the unique feature of the mouse genetics of which Myelencephalic Blebs afford an extreme example, "one of the most thrilling episodes in the history of genetics", where the embryology has with a bang disclosed completely the very complex nature of the genetical situation. The reviewer has great pleasure in quoting the following for it represents the lucid style of the author of the book as well as completes the story of Myelencephalic Blebs:—"Here, then, is the whole story. A normal process, the oozing of cerebro-spinal fluid through the foramen anterius of the fourth ventricle, is exaggerated. The blebs so produced are guided by purely mechanical forces along the curvatures of the body to their resting places, where they are eventually absorbed, but not before they have mechanically interfered with differentiating organs, in whose neighbourhood they may happen to lie. The distribution of the blebs is conditioned by the surface relief of the embryo, and genetic factors influencing the surface relief of the embryo secondarily influence the path which the blebs take."

In this very inadequate review one cannot close without referring to the literary aspect of the book. In a monograph of this nature where the author is forced to compress the vast material to the maximum limit, he can ill afford space for unnecessary digressions. But yet how appropriate and well-fitted are certain of the remarks scattered through the book. Here are a few examples. Discussing the waltzing mouse the author has a dig at our fair sex. "Females seem to be more persistent dancers than males, a parallel perhaps, to observations in human ball-rooms." Describing the expression of the gene Waved—1, the author writes, "the waviness in the earlier life looks as though the animals had been to the hair-dresser and had a permanent wave treatment". Discussing the colour genes the author says, "there are 2,755,620 possible different genotypes for coat colour. One cannot predict how many visibly different phenotypes correspond to this vast number"—a sentence over which Walt Disney may well contemplate!

By way of criticism the reviewer can say trivially little. He has found only two printing errors in the entire book: one, on page 139 where an 'o' in an 'of' has been omitted and on page 332, 'c' instead of 'e' has been committed to read 'case' instead of 'ease'. The style of necessity must be concise and hence, terse. But this is not unduly the case in the book except perhaps in the sections dealing with coat colour genes. A reproduction from the *Journal of Heredity* of the list of mutant genes and their recommended symbols as an appendix would have been desirable. Lastly, a few coloured plates of mice phenotypes due to few important colour genes might be included when the next edition comes out.

The book needs no recommendation to the professional geneticist. It is assuredly a 'must' item in his shelf. The book is of equal importance to the embryologist, anatomist, physiologist, pathologist and biochemist. It is a pity that few will have the opportunity of having an academic training such as our able author has, namely, in medicine as well as in genetics, and this is likely to make the very important knowledge contained in this book not easily intelligible to many. But this must not come in the way of the class of workers enumerated above making a serious study of the book and profiting immensely thereby. The lay reader in scientific matters if he is prepared for a certain amount of stiff reading, may well borrow the book from any accessible scientific library which must surely have a copy of its own.

B. SREENIVASAN.

A Dictionary of the Fungi. By G. C. Ainsworth and G. R. Bisby. (Imperial Mycological Institute, Kew, Surrey), 1943. Pp. viii + 359. Price 20*sh*. net.

This little book will be to the fungi what Willis's *Dictionary of the Flowering Plants and Ferns* has been to the higher plants. All the genera in use to the end of 1939 are stated to have been listed and their systematic position, present status, together with the probable distribution and the number of species comprising each genus, are given. Short accounts of orders, families, etc., definitions of mycological terms and common and scientific names of important fungi, are also included. In Wi[illegible] book there are brief notes on several impor[illegible] genera and the accounts of the families [illegible] more detailed. The value of this Dictio[illegible] would have been enhanced if the same pra[illegible] had been followed. Martin's key to the fa[illegible] lies of fungi and line drawings to illus[illegible] important genera are given at the end of [illegible] book.

The reviewer did not find the genera *[illegible]tiella* and *Agaricites* (fossil) mentioned [illegible] there may be others likewise which the aut[illegible] must have omitted for good reasons. [illegible] views regarding synonymy may not be acc[illegible] able to every one, so they caution, "the [illegible] reader will not take these, or the synon[illegible] to be true". It is now known that Jack[illegible] *Allopuccinia* is an obligate synonym of Sy[illegible] *Soratœa* but the authors accept both [illegible] genera without any comment. The aut[illegible] reject Thom's plea for using the name *As[illegible] gillus* for the perfect state and retain *[illegible] tium* for it and *Oidiopsis* is wisely retain[illegible] the Moniliales, the perfect state of that fu[illegible] being called *Leveillula*. A list of the aut[illegible] of genera and species is given on pp. 26-2[illegible] some important names like Bose, C[illegible] Clinton, Dastur, J. J. Davis, Garrett, Hira[illegible] (father and son), Long, Overholts, Sch[illegible] berg, Thom, etc., are missing. Biograp[illegible] notes of ten mycologists are given but [illegible] would have liked to know something [illegible] Broome, Corda, Jacjewski, Leveille, Rabenh[illegible] Ravenel, Rostrup, Schroeter, Thaxter, W[illegible] and others. There are not many printing er[illegible] but on page 6, line 1, 'Corde' is evident[illegible] misprint for 'Corda'; on page 242, line [illegible] 'Far.' for 'For.'; and on page 322, '*Xylospor*[illegible]' for '*Xylosorium*'. Indian mycological wor[illegible] as usual completely blacked out though In[illegible] Mycologists have made several impor[illegible] contributions to mycology and India contrib[illegible] handsomely to the income of the Imp[illegible] Mycological Institute which has sponsored [illegible] otherwise useful and interesting book.

M. [illegible]

District Industrialisation Drive. By Sir [illegible] Visvesvaraya. (All-India Manufactu[illegible] Organisation, Bombay), 1943. Pp. 44. [illegible] Re. 1.

Most progressive countries owe their com[illegible] rative prosperous position to their suprem[illegible] as an industrial nation. Industries are neces[illegible] for any high level of income, they are ne[illegible] sary for the manufacture of Defence machin[illegible] and they are indispensable for civilised exi[illegible] ence. And yet it is industries that have suffe[illegible] particularly neglect in India for many gene[illegible] tions. Therefore in any movement tow[illegible] progress at the present time in India, indust[illegible] rightly handled, may be expected to give [illegible] highest income for the money and energy [illegible] into them. In this brochure by Sir M. Vis[illegible] varaya issued by the All-India Manufactur[illegible] Organisation, detailed constructive suggest[illegible] are given for organising production by ind[illegible] tries in rural areas through formation of Vil[illegible] Group Committees, District Councils, City Co[illegible] cils, etc. The industries considered are prin[illegible] pally the small-scale or lighter variety, s[illegible] as connected with food, clothing and housin[illegible]

It is hoped that if modern scientific business and mass production methods are even partially applied to economic reconstruction, production of commodities in this country can be easily doubled, and income more than doubled in less than seven years. A study of the distribution of national income according to occupations shows that in India, the income from industries is about one-fifth of that from agriculture, while the reverse is the position in the United Kingdom and Sweden. In the one case it is also poverty, in the other prosperity.

A study of the brochure should infuse enthusiasm and give practical suggestions for all those who are interested in the rapid promotion of industries and industrial pursuits in Rural areas.

M. A. G.

Control of the Indian Electricity Supply Industry. By K. V. Karantha. (Published by the author, Post Box 156, Madras), 1944. Pp. 58. Price Annas 12.

In this booklet the author discusses the important question of the choice of agency for the management of electric supply undertakings in India and expresses the view that private enterprise is the best for controlling the industry as compared with Government or Municipal control. He further points out some of the defects of the private enterprise system and for remedy suggests the formation of an electricity board for each province entrusted with the work of rationalisation of license areas and rationalisation of electricity rates.

The booklet also contains, for purposes of comparison, a brief survey of certain aspects of electric supply work in other countries such as U.S.A., New Zealand, U.S.S.R., and Great Britain.

The subject-matter of the booklet is one of considerable importance as it has a direct bearing on post-war development and the views set out by the author as a result of his wide experience of the electricity supply industry in the Madras Presidency, would be indeed very valuable in any planning, to ensure electricity supply in the most efficient manner.

H. N. R.

COLD DENSE-MATTER*

FROM the dawn of Science, natural philosophers have speculated on the atomistic structure of matter, but it was only after the formulation of Newtonian mechanics and developments in analytical dynamics that the atomic concept proved fruitful in interpreting and analysing the physical properties of matter in bulk in terms of the properties of constituent atoms and the laws of interaction between them. It marked a great advance, when, on the one hand, Drude, Lorentz and Richardson amongst others recognised explicitly that the general laws of the 'classical kinetic theory of gases' discovered by Maxwell and Boltzmann could be extended to sub-atomic particles, *e.g.*, the electrons, and, on the other hand, when Einstein and others applied them to particles of more 'usual' size than gas molecules, *e.g.*, colloid suspensions. However, this extension of classical statistical mechanics to electrons led in many cases to serious difficulties and contradictions. The situation was changed when in 1926 Fermi, and independently Dirac, found that classical statistics was inconsistent with Pauli's exclusion principle, the electrons obeying a new statistics called Fermi-Dirac. On the other hand photons and alpha-particles obey what is called Bose-Einstein statistics, after Bose, who first in 1926 formulated it in connection with photons, and Einstein who applied it to material particles. The statistics, Fermi-Dirac or Bose-Einstein, that a particle (or a system) obeys is determined by its spin. Particles which possess zero or integral units of spin (the unit being $\hbar$) obey Bost-Einstein statistics, whereas particles possessing half-integral units of spin obey Fermi-Dirac statistics.

The new statistics has proved fruitful in the understanding of atomic phenomena of the most diverse kinds. In the case of a gaseous assembly of similar particles, for high temperatures or low enough concentrations, the new statistics tends to the classical one, whereas, when the temperature is low or the concentration high, there is a wide divergence from classical result. These two limiting cases of the new statistics are called non-degenerate and degenerate respectively. In a non-degenerate (*i.e.*, classical) gas the pressure depends upon the product of the temperature and the concentration, whereas in degeneracy the pressure is (almost) independent of the temperature for a Fermi-Dirac gas, and independent of the concentration for a Bose-Einstein gas, *i.e.*, one of the variables, temperature or volume is relegated to the background.

The first astrophysical application of Fermi-Dirac statistics was made by Fowler, and this was followed by the work of Frenkel, Majumdar and Stoner amongst others. Milne has incorporated the new statistics in his extensive investigations on stellar structure, and the application of its relativistic modification to equilibrium configurations of white dwarfs has been worked out in complete detail by Chandrasekhar.

In Bose-Einstein degeneracy the particles in the assembly are distributed between two phases, the so-called condensed phase and the energetic phase—these two phases are co-extensive in (ordinary) space but separated in momentum space. The condensed phase is constituted by particles that are in the state of lowest kinetic energy possible for a particle in the assembly.

It is interesting to note that in the theory of liquid structure where a liquid is regarded as a continuous medium, permeated with "holes", which presumably obey Bose-Einstein statistics,

---

* Summary of Presidential Address delivered by Prof. D. D. Kosambi, before the Section of "Physics" at the Indian Science Congress, held at Delhi last January.

the holes can constitute a condensed phase. For the hole-model of a liquid it is of great importance to construct formally the Schrödinger equation and determine the eigen-values for its energy. The energy levels are found to be discrete, and the theory gives expressions for melting point and latent heat of fusion in terms of the surface tension of the liquids. It is tempting to observe that the energy levels of a hole may reveal their presence in scattering and ultrasonic phenomena.

After describing some properties of black-body radiation and the transformation of matter into radiation, the properties and astrophysical applications of degenerate matter are dealt with. Degenerate matter is material which is composed of ionised atoms, the free electrons constituting a degenerate gas in the sense of Fermi-Dirac statistics. The question arises 'how and under what conditions atoms become ionized and generate a gas of free electrons?' There are two ways in which atoms become ionized: (1) Temperature ionization and (2) Pressure ionization.

The theory of temperature or thermal ionization was given by Saha about twenty years ago and, if the value of discovery is to be judged by the fruitfulness of its consequences, the discovery of Saha should be regarded as one of the most important in modern physics. In thermal ionization temperature plays a denominating role and pressure and density only a secondary part. In degenerate matter on the other hand the ionization is essentially controlled by the density or pressure—in degeneracy, pressure depends mainly on the density of the material and very little on the temperature.

The theory of pressure ionization finds its most interesting application in explaining the mass-radius relation for white dwarfs and planets. In deriving the mass-radius relation the effect of the electrical field existing inside the configuration is taken into account. The theory predicts that in the white dwarfs stellar material must be completely ionized. In the usual white dwarf theory it is taken as an assumption here it follows naturally from the theory. In the case of planetary masses the degree of ionization depends on the mass and decreases rapidly with falling mass.

It is interesting to observe that for the newly discovered planet (mass $0 \cdot 016 \odot$) of the star 61 Cygni, the theory gives a radius of 3×10^9 centimetres if we assume it to be composed entirely of helium. For hydrogen the radius is three times larger.

Perhaps the most significant prediction of the theory is that there cannot be a cold body (planet or white dwarf) appreciably larger in size than Jupiter.

The relativistic modification of the mass-radius relation is also discussed and the treatment given by Kothari is in some respects different from the usual one. The problem of energy generation in white dwarf stars and the question of existence of hydrogen inside them is discussed at length.

TRUTH IN ANTHROPOLOGY*

THERE is very great need of a high standard of Truth in all our field work in Anthropology for anthropology is regarded with some suspicion in India. The attempt of certain scholars and politicians to classify the aboriginal tribes as non-Hindu created the reasonable impression that the science was being diverted to political and communal ends; the animism of the aboriginals belongs to the Hindu family obviously. But the chief thing that disturbed nationalist opinion in India was the creation of the Excluded and Partially Excluded Areas on the move made by a distinguished anthropologist. This arrangement has failed to give the tribes the liberty and protection they want and is to be condemned scientifically. Further, most of the published books on Social Anthropology do injustice by writing in a ridiculous strain about India. Really India's aboriginal population is splendid, verile, honest and kindly and is admirable and worthy of preservation. The publications of the Functional School show that these primitive communities are admirable and lovable. The Ethnographical Survey publications were, however, too bureaucratic, superficial and scrappy, while the Census of India published inaccurate notes on curiosities. Both of these depended on information provided by clerks and other untrained persons; the monographs of the Ethnographic Survey had numerous repetitions. This is the reason why India is almost neglected in the general works on Anthropology, which reproduce the opinions of irresponsible writers with political respectability.

In the interests of truth in anthropology, several things may be emphasised. The investigator should spend several years among the people he studies, knowing their language, and putting himself in sympathy with them. This would be easier for Indian enquirers. He should be 'a detective and a magistrate', for the tribes generally conceal many real facts and motives, or professional informants are unreliable and desirous of publicity more than truth. Negative replies are to be suspected, and conclusions should be firmly based on statistics. The evidence of tribal poetry, folksong, story, proverb and riddle is valuable. The publications also should be well printed and illustrated and expert help should be taken in these matters. Very few Indian words should be given in the text and where given, diacritical marks should be avoided as far as possible. Art and poetry are the sisters of science, in the great family of Truth.

A whole world of Indian life and culture is passing away without proper record and it is high time that we do our field work properly with reference to Truth. But the Truth of science is no static thing, for the scholar passes from truth to truth towards Eternal Truth in which he will find immortality.

M. H. K.

* Summary of the Presidential Address delivered by Mr. Verrier Elwin, M.A. (Oxon.), F.R.A.I., F.N.I., before the Anthropology Section of the Indian Science Congress held at Delhi last January.

SCIENCE NOTES AND NEWS

A central controlling authority to organise university education, in the interests of the country as a whole is suggested as a part of post-war educational reconstruction which has received the approval of the Central Advisory Board of Education. This authority is proposed to be constituted on lines analogous to the University Grants Committee in Great Britain. Its main function would be to settle the assessment and distribution of all grants from public funds and to enable universities to plan ahead. It will be empowered to encourage private benefactories, to co-ordinate university activities, to avoid overlapping and to adjusting the output of universities to the economic needs of the country, to examine and advise upon all schemes of major development, to prevent undesirable competition between universities and to remove all provincial barriers, to arrange for the periodic inspection of universities, to ensure the maintenance of standards, to establish cultural contacts and to arrange for the exchange of teachers and students with foreign universities.

A comprehensive plan of post-war educational development in India, based mainly on the Sargent Scheme, has been drawn up by the Central Board of Education and is being submitted to the Reconstruction Committee of the Viceroy's Executive Council. The Scheme is the result of the work of the various Committees set up by the Board, including the two Wardha Education Committees. The total annual cost of the National system of education as envisaged by the Board will amount to 277 crores of rupees.

To advise the Government of India on problems of dehydration of meat, fish, fruits and vegetables an Empire Mission on Dehydration, consisting of Dr. J. C. Fiddler of the Ministry of Food and Cambridge Low Temperature Research Station, and Mr. T. C. Crawhall, Deputy Director, Dehydration, Ministry of Food, are now touring India. They will visit important factories in India where dehydration of meat, fish, fruits and vegetables for the army is being carried on and also the centres of supply of these products. They will also visit research centres in India.

It is proposed to establish a Central Coconut Committee which will, in the first instance, as a war measure, be entrusted with the task of stepping up the production of the produce by improved methods of manuring and cultivation. The necessary funds for the purpose will be met by the levy of a cess at Rs. 3-2-0 per ton of copra consumed by the mills. The annual revenue from this source is expected to amount to three lakhs.

The half-yearly meetings of the Indian Central Cotton Committee began on the 24th January and concluded on the 29th January 1944, Sir Pheroze Kharegat, C.I.E., I.C.S., Vice-Chairman of the Imperial Council of Agricultural Research, presiding. His Excellency the Governor of Bombay, Sir John Colville, attended the meeting of the main Committee on the 28th January and paid tribute to the work done by the Committee for the improvement of Indian cotton and in the interests of the cotton industry as a whole.

Sir Chunilal B. Mehta was elected Vice-President for the year 1944-45, and the following were appointed to constitute the Standing Finance Sub-Committee for the same period: Sir Chunilal B. Mehta (Vice-President) (*Chairman*), Sir Pheroze Kharegat, C.I.E., I.C.S. (*ex-officio*), Sir Chunilal V. Mehta, K.C.S.I., Sir Purshotamdas Thakurdas, C.I.E., M.B.E., Sir Sorab Saklatvala, Mr. J. L. Hurschler, Rao Bahadur Sir Madhaorao Deshpande, K.B.E., Mr. W. J. Jenkins, C.I.E., Mr. R. G. Saraiya, O.B.E.

There were some seventy items on the agenda, most of which, however, had been previously reviewed by the appropriate Sub-Committees and the Committee considered them in the light of the recommendations made on them by the Sub-Committees. Considerable discussion centred round the question of the desirability of taking legislative or other measures to prevent mixing of cottons in India. The consensus of opinion was strongly in favour of immediate action in the matter but, in view of the complexity of the problem, it was finally decided to authorise the Local Sub-Committee to go into the matter fully and suggest measures for stopping the malpractice.

Among the new schemes sanctioned by the Indian Central Cotton Committee, are a scheme for cotton physiological research, a scheme for improvement of Hill cottons in Assam, a scheme for distribution and multiplication of "Vijaya" in Baroda District and a scheme for distribution and marketing of Jarila in the Central Provinces and Berar. The following schemes due to terminate in the course of the year have been recommended for extension for varying periods:—(1) Central Provinces and Berar Cotton Breeding Scheme, (2) Mysore Doddahatti Scheme, (3) Scheme for co-ordination of research on Black-headed Cricket in Sind and Baluchistan, (4) Scheme for distribution and marketing of V. 434 cotton in Central Provinces and Berar, and (5) Scheme for grading and marking of 1027 A.L.F. and "Suyog" cottons in Surat District.

About 15 million acres of waste land will be brought under land development and reclamation scheme by the Government of Bombay as

a major part of its post-war reconstruction plan. The total cost of the scheme is expected to be Rs. 15 crores and its working is expected to extend over a period of five years. An essential phase of the development is the large-scale contour-bunding to conserve the available water-supply and to enable the extension of scientific dry farming. Afforestation and terracing of hill sides will be undertaken to conserve water.

The Government of India have entrusted to the Drugs Technical Advisory Board, established under the Drugs Act, 1940, the task of preparing an Indian Pharmacopœial list.

The Indian Metallurgical Association has donated a sum of Rs. 10,000 to the Council of Scientific and Industrial Research to be utilised by the Council, at its discretion, for the purpose of "promoting, encouraging and benefiting the interests of metallurgical industry in India".

With a view to widen the scope of the activities in industrial research in relation to the development of industries in the State, and to secure a closer and more effective contact with the Board of Scientific and Industrial Research of the Government of India, the Government of Mysore have reconstituted the Board of Industrial Planning and Co-ordination in Mysore. The reconstituted Board has been named the Board of Scientific and Industrial Research, and consists of eight members including Sir C. V. Raman, Sir J. C. Ghosh and Sir M. O. Forster.

The Hon'ble Mr. M. S. A. Hydari, C.S.I., C.I.E., I.C.S., Secretary, Department of Industries and Civil Supplies, was elected Vice-President of the Council of Scientific and Industrial Research, for a term of two years, at the meeting of the Governing Body of the Council held at Bangalore on December 1, 1943.

Sir Shanti Swarup Bhatnagar, Kt., F.R.S., Director, Scientific and Industrial Research, Delhi, has been elected Vice-President of the Society of Chemical Industry in London.

Dr. B. Viswa Nath, who has just retired from the Directorship of the Imperial Agricultural Research Institute, has accepted the offer of the Government of Madras, to take charge of the Director of Agriculture from the 15th April 1944.

It is understood that Sir S. S. Bhatnagar, Kt., F.R.S., will fly to Chunking in response to an invitation which has been extended to him by the Chunking Government.

On the recommendation of the Vincent Massey Scholarship Selection Committee, H. E. the Viceroy has awarded the Vincent Massey Scholarship for 1943-44 to Mr. P. S. Anantha Narayan, Labour Officer, the Tata Oil Mills Company, Bombay.

Nature, December 1943, records the obituary of Dr. W. H. Hatfield, F.R.S., the famous metallurgist and Director of Brown Firth Research Laboratories, Sheffield. The success of the "18:8" nickel chromium steel to which Firths gave the name of "Staybrite" is largely due to his energetic efforts. He made a detailed study of the properties of austenitic stainless steels, especially of the intercrystalline corrosion to which they were liable under certain conditions, as when welded. He was elected a Fellow of the Royal Society in 1935.

Dr. A. S. Kalapesi's Presidential Address to the Geology and Geography Section deals with a brief review of the geographical and geological features of "The Bombay Island". Starting from the earliest reference to this part of the West Coast of India so far back as 150 A.D. by Ptolemy, Dr. Kalapesi proceeds to give a detailed historical account of the gradual evolution of the Bombay Island as a single unit from seven different islands. He next deals with the rocks of the Island and points out that while the main rock formation throughout the area is the Deccan Trap, there are evidences here of three or four 'local' and 'secondary' effusions of lava which seem to have taken place sometime after the main Deccan Trap eruptive activity came to an end, and are perhaps connected with the foundering of the land which extended towards the west of the present coastline of the Peninsula after the highest Deccan lava flows had consolidated. The Address concludes with a general account of the younger volcanic rocks due to these different 'effusions' and their distribution in different parts of the Island.

In his Presidential Address to the Mathematics and Statistics Section, Dr. B. M. Sen purports to give an account of quantum mechanics from the standpoint of a mathematician. A brief description of the Bohr Theory is followed by a mention of the matrix mechanics, and the Schrödinger Equation. Dirac's relativistic wave equation is then touched upon, and a reference is made to Eddington's theory. A brief mention is also made of the theory relating to particles of spin zero and one.

The Government of India have entrusted to the Drugs Technical Advisory Board established under the Drugs Act, 1940, the task of preparing an Indian Pharmacopœial List.

There are a number of drugs of Indian origin which are of sufficient medicinal value to be officially recognised and which are prescribed in India by practitioners of modern scientific medicine not included in the British Pharmacopœia. Pharmacopœial drugs are also produced in India from medicinal plants of a slightly different species from those described as standard in the British Pharmacopœia. It is necessary to prescribe official standards for such drugs in order to secure uniformity of strength, quality and purity.

The Indian Pharmacopœial List will be the official standard for drugs not included in the British Pharmacopæia and will serve as the official Supplement to the British Pharmacopœia. In preparing the List the Board will have the advantage of the considerable material collected as a result of the enquiry into

indigenous drugs conducted over a period of years under Lt.-Col. Sir R. N. Chopra.

At the annual general meeting of the Indian Botanical Society held at Delhi early last month, Prof. Yajnavalkya Bharadwaja, Head of the Department of Botany and Dean of the Faculty of Science, Benares Hindu University, was elected President of the Society. The following, among others, were elected members of its Executive Council:—Prof. Birbal Sahni, F.R.S. (Lucknow), Principal P. Parija, O.B.E., I.E.S. (Cuttack), Dr. T. S. Sabnis, I.A.S. (Cawnpore), Prof. S. P. Agharkar (Calcutta), Prof. T. S. Raghavan (Annamalainagar), and Prof. F. R. Bharucha (Bombay).

The Madras Engineers' Association has transferred Rs. 15,000 from its funds to the University of Madras for the institution of a research scholarship in Engineering.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of November 1943, there were two of great, two of moderate and five of slight intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T. H.	M.	Epicentral distance from Bombay (Miles)	Co-ordinates of epicentre (tentative)	Depth of focus (Miles)	Remarks
2	Slight	10	09	1370	..	..	..
3	Moderate	00	38	7700	..	..	..
3	Moderate	21	02	6550	..	..	..
6	Great	15	02	4490	..	130	..
24	Slight	19	47	3160	..	..	..
27	Great	04	51	2890	..	..	Epicentral region in Turkey. Great loss of life and property reported in press.
27	Slight	15	15	910	..	..	..
28	Slight	12	50	3640	..	..	..
30	Slight	03	48	5070	..	..	..

Three crystal reliquaries have been discovered at a Buddhist site, known as Salihundam, near Chicacole in the extreme north of the Madras Presidency.

The attention of the Archæological Department was attracted to the site over twenty years ago. Last year a group of Buddhist religious buildings consisting of a chaitya and three stupas were discovered. One of them has now yielded three crystal reliquaries within three stone relic-boxes. The crystal caskets are hemispherical and are shaped like stupas and contain gold leaves embossed with lotus leaf decorations.

The remains at Salihundam indicate the flourishing state of Buddhism in the northern Andhra country under the Ikshvaku rulers.

Prof. Moses Ezekiel, Professor of Botany, Wilson College, Bombay, has observed that *Sopubia delphinifolia*, a well-known root-parasite on grasses, also parasitises the tomato plant. A distinct root connection between the host and the parasite has definitely been established.

The C. P. and Berar Provincial Board of the All-India Manufacturers' Organization has invited the All-India Manufacturers' Organization to hold its fourth Annual Session at Nagpur on 26th and 27th February 1944. Sir M. Visvesvaraya has kindly consented to preside.

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory, Bombay, during the month of December 1943, there were one of moderate and five of slight intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin (I.S.T.) H.	M.	Epicentral distance from Bombay (Miles)	Co-ordinates of epicentre (tentative)	Depth of focus (Miles)
3	Slight	11	08	4810	..	
5	Slight	09	46	1230	..	100
6	Slight	12	40	2520	..	70
12	Slight	22	24	1270	..	..
13	Slight	14	23	1350	..	..
24	Moderate	01	24	7610	..	..

MAGNETIC NOTES

Magnetic conditions during January 1944 were less disturbed than in the previous month. There were 14 *quiet* days and 17 days of *slight* disturbance as against 18 quiet days, 11 days of slight disturbance and 2 days of moderate disturbance during the same month last year.

The quietest day during the month was the 30th and the day of the largest disturbance the 1st.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Moderate
4, 5, 7–9, 19–24, 28–30.	1–3, 6, 10–18, 25–27, 31.	

No magnetic storm occurred during the month of January 1944, while two moderate disturbances were recorded in January 1943.

The mean character figure for the month of January 1944 was 0·55 as against 0·48 for January last year.

A. S. CHAUBAL.

University of Madras.—Applications are invited for the following appointments in the University of Madras:—

(1) Director (Professor) of the Research Laboratory in Zoology on a salary of Rs. 750-50-1,000.

(2) Director (Professor) of the Research Laboratory in Botany on a salary of Rs. 750-50-1,000.

Applicants should be graduates of Indian or British Universities with high academic qualification and should have sufficient experience of research work. For appointment to the post of Director (Professor) of the Zoological Laboratory, a knowledge of Marine Zoology will be an additional qualification.

Applications (eight copies) containing full particulars regarding (*i*) age, (*ii*) religion and caste or community, (*iii*) academic and other qualifications, (*iv*) original research and publications, if any (copies to be submitted), (*v*) present position and salary, together with copies of recent testimonials and names of two persons to whom a reference can be made, should be sent so as to reach the Registrar, University of Madras, Chepauk, Triplicane, Madras, on or before the 15th March 1944, with the envelope superscribed as "Director, Zoology/Botany Laboratory".

(3) Professor in the Department of Chemical Technology on a salary of Rs. 750-50-1,000.

Applicants should (*i*) possess high academic qualification, (*ii*) have wide experience in Chemical Technology or Chemical Engineering, (*iii*) possess a degree of a recognised university and (*iv*) be able to produce a record of research in one of these subjects. The person selected for the appointment will be required to organise the Department of Chemical Technology, direct research in Chemical Technology, or Chemical Engineering, and generally to do such work as may be necessary for the starting and working of the Department.

Applications (eight copies) containing full particulars regarding (*i*) age, (*ii*) religion and caste or community, (*iii*) academic and other qualifications, (*iv*) previous teaching and technical experience, (*v*) original research and publications, if any (copies to be submitted), (*vi*) patents, if any, and (*vii*) present position and salary, together with copies of recent testimonials and names of two persons to whom a reference can be made should be sent so as to reach the Registrar, University of Madras, Chepauk, Triplicane, Madras, on or before the 15th March 1944, with the envelope superscribed as "Professor in the Department of Chemical Technology".

The appointments will be, in the first instance, for a period of three years and will be subject to confirmation at the end of that period.

It will be open for the appointing authority to select a candidate for appointment either in the grade of Professor or in the grade of Reader (Rs. 400-25-600), taking his qualifications and experience into consideration. It will also be open for the appointing authority, in exceptional circumstances, to make short-term contract appointments on special terms.

Further particulars relating to the above appointments can be had from The Registrar, University Buildings, Chepauk, Madras.

The 1944 Easter Session of the Indian Academy of Sciences will be held at Madras from 7th April 1944 to 9th April 1944 in the University Buildings. Apart from the reading of papers, there will be special discussions on "Luminescence" and "Hydrogen Bonds".

We acknowledge with thanks the receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 92, Nos. 4653-4654.

"Journal of Agricultural Research," Vol. 67, Nos. 3, 5 and 6.

"Agricultural Gazette of New South Wales," Vol. 54, Pts. 11-12.

"Allahabad Farmer," Vol. 17, No. 6.

"Biological Reviews," Vol. 18, Nos. 3-4.

"Journal of the Indian Botanical Society," Vol. 22, Nos. 5-6.

"Biochemical Journal," Vol. 37, No. 4.

"Journal of Chemical Physics," Vol. 11, No. 10.

"Journal of the Indian Chemical Society," Vol. 20, No. 11.

"Chemical Products and Chemical News," Vol. 7, Nos. 1-2.

Industrial and News Edition of the "Journal of the Indian Chemical Society," Vol. 20, Nos. 3-4.

"Endeavour," Vol. 1, Nos. 1 to 4; and Vol. 2, Nos. 5 to 8.

"Experiment Station Record," Vol. 89, No. 4.

"Indian Farming," Vol. 4, No. 8.

"Indian Forester," Vol. 70, No. 1.

"Indian Forest Records," Vol. 3, No. 4.

"Indian Forest Leaflet," No. 57—1943, and 61.

"The Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 15, No. 3.

"Chronicle of the Health Organisation," Special Number, October 1943.

"Bulletin of the Indian Central Jute Committee, Vol. 6, Nos. 9-10.

"Journal of the Indian Mathematical Society," Vol. VII, Nos. 1-2.

"Mathematics Student," Vol. 10, No. 4.

"Indian Medical Gazette," Vol. 78, No. 12; Vol. 79, No. 1.

"The Review of Applied Mycology," Vol. 22, Pts. 10-11.

"American Meteorological Society Bulletin," Vol. 24, No. 56.

158-44—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

CURRENT SCIENCE

Vol. XIII] MARCH 1944 [No. 3

PAGE

GENETICAL RESEARCH AS APPLIED TO PLANT BREEDING IN POST-WAR INDIA

IN any scheme of organisation of scientific research in India for national development, the study of Genetics should receive its proper attention. It is a young and rapidly growing science basic to modern plant breeding which is practised in all civilised countries for increased production of farm, forest and fruit crops. It is true that for thousands of years before the discovery of genetical methods for breeding, superior varieties of crops were produced; but these were mainly due to the efforts of individual, intuitive, clever men who applied a sort of conscious selection to the large number of variants occurring spontaneously or induced by random racial crossing. With the development of genetical knowledge during the present century, however, breeding practice was rationalised and many wrong corners and pitfalls which beset early breeders were removed. The concept of the *gene* as the unit of inheritance and the identification of the chromosomes as a string of genes controlling development, variation and evolution in living organisms have put new tools in the hands of the breeder. Recent knowledge regarding induction and utilisation of polyploids, wide crosses, mutants and hybrid vigour, arising from genetical researches, has opened up new possibilities for increased production. In fact, the new knowledge that has accumulated from researches on chromosomes—the bearers of hereditary characters—has made it possible to make new plants to order. The advice of one of the greatest authorities in genetics to breeders who desire to be most practical—"Know your chromosomes"—indicates the importance of the study of Genetics.

It may not be out of place here to briefly mention how genetic research is being applied to secure increased production in some of the more progressive countries.

Genetic Research Abroad

Taking the case of Sweden, since the last War (1914-18) she has made tremendous progress in the matter of production of food and other crops as a result of the application of genetic research to plant-breeding. The annual yields of wheat and sugar-beet have been raised to a level at which the country is self-sufficient. This has been done by the application of new techniques such as by the use of twin seedlings, heat, colchicine, etc., for producing tetraploids and other suitable synthetic types. Tetraploid forms of clover, lucerne, herbage grasses, barley, rye, potatoes, flax and other crops have also been produced and some of them have already been found to be of practical use. Amphidiploid wheat-rye hybrids, first raised in the U.S.S.R., are now regularly produced by doubling of chromosomes in crosses between suitable parents for different conditions and purposes. A new grain crop, *viz.*, *Triticale*, of special value for Sweden and other countries has been synthesised—"the first such invention for the last three thousand years". Higher yielding barley strains have also been obtained from X-rayed progenies; thus dispelling the misgivings of geneticists

regarding the value of X-ray mutants for breeding purposes.

The nutritional aspect in breeding was not lost sight of. Triploid apples with richer vitamin and better keeping quality have been obtained and potato varieties with higher ascorbic acid content are being bred.

Realizing the importance of breeding to forest trees, researches were initiated and within a short period significant results have been obtained. A survey of the forest resources in the country was made and triploid aspens and other trees with twice the growth-rates of the neighbouring diploid trees have been obtained. Polyploidy is being induced artificially in other trees for production of superior forms. Newer methods of propagation and grafting are also under investigation. Fundamental researches in genetics and cytology carried out at the cytogenetic laboratory in Svalöf are discovering new principles and techniques of paramount importance to breeding.

In the U.S.S.R. new and peculiar problems of production are being solved by the application of genetic research. Heavy frost and drought are constant enemies to successful crop production in that country. New synthetic crops are being produced from wide crosses which heretofore were considered useless because of the sterility involved in them, to suit different conditions and purposes. The amphidiploid hybrids of wheat with rye, *Agropyron* and *Ægilops* are a few instances in point. Extensive interspecific and intergeneric hybridisations have been undertaken in that country for the production of desirable types in rye, potato and other crops. This has been made possible by the wonderful wealth of wild genes the Russian geneticists have built up in their living collections of less well-known economic plants by surveying their own country and by sending out expeditions to other countries of origin of cultivated plants. A remarkable instance of this type of work concerns the potato. The potato introduced into Europe three and a half centuries ago set seed readily and gave rise to a number of varieties by segregation in the course of a number of years. The genes present in these varieties were utilized and all the desirable combinations of them were obtained and ultimately a position of stalemate was reached when no further improvement appeared possible although several problems such as those of Late Blight and virus diseases were unsolved. The necessity for importing fresh genes for disease-resistance was felt and a search for these genes in the original home of the potato was undertaken. Expeditions were sent to Central America and Mexico between the years 1926 and 1932 by the Russian geneticists and a large number of hitherto unknown tuber-bearing *Solanums* was discovered. As a result of this, a revolution in our ideas as to the origin and botanic status of the potato has occurred and possibilities of breeding potato to all the desired requirements of industrialised man are in sight. Another very important discovery of a Russian geneticist concerning the chimeral nature of many of our domestic potatoes has proved to be of great significance to breeding.

The extensive collection of living plants has also helped in bringing into cultivation new and substitute crops whenever found necessary. The new investigations of the Russian geneticists on the breeding of rubber plants from *Taraxacum koksaghyz* and other *Compositæ* are examples.

In America, the conquest of stem rust and other diseases of wheat and the production of hybrid corn, which has literally revolutionised corn production in that country, are eloquent testimonies to the successful application of genetic principles to increased crop production.

In England, continued cytogenetic researches on fruit trees, particularly those belonging to the genera *Fragaria, Rubus* and *Prunus*, have thrown light on the origin of many of these cultivated fruits and the mechanism of reproduction in them and has helped in the evolution of new and superior varieties.

With this background of research activities abroad it may be worthwhile to examine the status of genetic research in India and the possibilities of its extension in the future for national development.

Present Position of Genetic Research in India

The application of genetic research to increased crop production may be said to have started in India with the opening of the Imperial Agricultural Research Institute and the Provincial Departments of Agriculture about the year 1905. The establishment of the Indian Central Cotton Committee and the Imperial Council of Agricultural Research later on, also supplemented activities in this direction. So far, the plant breeders and geneticists have produced many superior yielding crop varieties, mainly by the application of the time-honoured method of selection to naturally varying populations or to the segregates of inter-racial hybrids. Considerable success has been obtained with self-fertilized crops like the cereals and with the vegetatively propagated sugarcane. Breeding for special attributes such as disease- and pest-resistance, better quality and adaptability to regions of drought and frost have not made much progress. Suitable techniques for breeding cross-fertilized crops like mustards and maize have not been thoroughly worked out. Fundamental genetic research such as would lead to the discovery of new principles and techniques has not been taken up on a large scale. No doubt the inheritance of several morphological characters in a number of crop plants has been studied but these characters are of very limited application to breeding compared to the more complicated physiological characters which control yield and quality and which have received very little attention in India. The extensive use of the new weapons of genetic research such as polyploidy, hybrid vigour, mutations, chimeras, etc., in breeding has not

come into vogue in this country. Researches on modern lines have, however, been taken up only recently at the Imperial Agricultural Research Institute and already results of promise are indicated. Isolated experiments in productive genetics are also being made in a few other centres but much more remains to be done. If we are to advance in the future with regard to the solution of our varied problems in crop production, we have to bring into being a vastly expanded and co-ordinated plan of active research in pure and applied plant genetics whereby the breeding material and methods at our disposal could be enriched for exploitation by the breeder. The following are a few suggestions for the organisation of genetic research in India.

Some Suggestions for the Future Organisation of Genetic Research in India

The entire programme of work in connection with the improvement of crops in so far as it relates to breeding by genetical methods, may be divided into (1) Long-range research for discovering material, principles and techniques for breeding; and for training geneticists, (2) breeding for yield and other qualities in crops and (3) testing, multiplication, certification and distribution of bred varieties.

1. *Long-range Research.*—The long-range research should be located in the Central Research Institute, whose functions will be roughly as follows:—

(*i*) The survey and collection of the economic plant material including allied species of cultivated plants in the country and their systematic analysis with regard to their inherent useful qualities, their capacity to transmit them when crossed and the working out of techniques for obtaining such crosses for utilization in breeding. The work of the survey may be vested in a Bureau of Plant Introduction such as was pointed out by Dr. Pal in the Soils Wing Meeting of the Board of Agriculture, 1942, which will function as a wing of the Institute with a well-trained staff of geneticists and taxonomists. The universities may be called in to help in collecting information and material during tours of their staff and students in their respective provinces. The testing of the entire material could not, of course, be done in the main Central Institute owing to different climatic requirements of the plants and, therefore, a number of sub-stations in the different climatic zones will be needed for the purpose. The Bureau will also undertake introduction of plants from outside whenever possible. The materials accumulated and the experience gained with them will prove of great use to breeders of different crops situated in different localities.

(*ii*) Fundamental genetic research for discovering the best techniques connected with breeding of the different types of crops such as self-fertilized, cross-fertilized and vegetatively propagated ones and evolution of new principles and methods discovered elsewhere for application to Indian conditions and crops.

(*iii*) Breeding of special crops and for special requirements for which the Central Research Institute is best fitted by virtue of its well-equipped laboratories and staff, as for instance, the breeding of potatoes and disease-resistant wheats.

(*iv*) Training post-graduate students in genetics and plant breeding. The Central Research Institute should be the best place for giving such training as it will be in touch with high-class fundamental research. For the training to be effective, it is necessary for the universities to devote more attention to the teaching of genetics, which unfortunately at present, is not receiving the attenion it should. It is indeed a sad state of affairs that none of the many universities in India has a chair of genetics.

2. *Breeding Stations.*—For breeding superior strains of crops with required qualities, one or more breeding stations for each commodity may be set up in the areas typical for those crops. Each station, besides the other agricultural specialists, should have on its staff a well-trained geneticist who will help in the formulation and conduct of the breeding experiments. The breeding stations will work in collaboration with the Central Research Institute and will derive help from the latter both in regard to breeding material and techniques.

3. *Testing Stations.*—Small testing stations attached to each of the commodity breeding stations may be set up with a limited staff of agronomists and breeders to test out the bred varieties for their suitability to the different areas. At the testing stations, the potentiality of the different strains to respond to cultural and manurial treatments will also be tested. Multiplication, certification and distribution of approved seeds may also be supervised by the staff which may include a pathologist and an entomologist.

The above are only a few suggestions which may provide some basis for the organization of genetic research for improving crop production in this country. The question as to how the entire organisation should be secured and controlled is a matter for administrative authorities to decide.

S. Ramanujam.

PROFESSOR SUBRAMANYA CHANDRASEKHAR, F.R.S.

NOT a few Indian intellectuals have found a congenial home in the United States of America and are engaged in scientific or industrial pursuits with great credit to themselves and to the land that gave them birth. Amongst these, by far the best-known internationally is the young Indian who holds the Chair of Theoretical Astronomy and Astrophysics at the Yerkes Observatory of the University of Chicago. The very high estimate in which Dr. Chandrasekhar is held by his colleagues at Yerkes Observatory and by American astronomers generally was demonstrated in practical fashion by his recent promotion from an associate to a full professorship in the University. He has already built up around himself a strong school of young American investigators, and the place he has made for himself is being increasingly recognised as one indispensable for the progress of astronomy in his country of adoption.

Professor Chandrasekhar is only 33 years of age. His election to the Fellowship of the Royal Society announced in a recent message of Reuter from London is one of the series of notable academic and scientific distinctions he has already achieved. As in the case of the late Mr. Ramanujam, the F.R.S. was preceded by the distinction—unique for an Indian—of the Fellowship of Trinity College at Cambridge. Last year, the New York Academy of Sciences crowned his work on stellar dynamics by the award of a coveted prize. A list of the Universities and of the learned societies in Europe and America which have honoured Chandrasekhar by an invitation to lecture before them and shown their appreciation of his contributions in one way or other would be a lengthy document. The Harvard University was one of these, and the lecture course he delivered at that great centre of learning resulted in an invitation to join the staff of its well-known astronomical observatory. Chandrasekhar, however, preferred the position he now occupies at Chicago, in view of the opportunities which the chair gives him of being in constant contact with the work of an active group of astronomers at a number of observatories including that at Yerkes.

Dr. Chandrasekhar's publications cover many aspects of Astronomy and Astrophysics. During his Cambridge period, his papers appeared for the greater part in the *Proceedings of the Royal Society* of London and the *Monthly Notices of the Royal Astronomical Society*. After he went to Chicago the papers by himself and his collaborators are a regular feature in the *Astrophysical Journal*. A complete bibliography of these would include over eighty titles. Special mention should be made of three major treatises which Dr. Chandrasekhar has written during recent years, and in which the interested reader can find an exposition of his ideas and contributions. The first book entitled "An Introduction to the Study of Stellar Structure" was published in 1939 as one of the series of Astrophysical Monographs issued by the University of Chicago Press. This treats in a deductive manner the subject of stellar interiors, the necessary physical theories and mathematical methods being fully explained. The treatise includes accounts of the foundations of thermodynamics, the theory of radiation, the quantum theory of a perfect gas, and a discussion of the elements of nuclear physics. The whole subject is presented with enviable crispness and clarity of expression. The second treatise entitled "The Principles of Stellar Dynamics" appeared in the same series in 1942. In this monograph the dynamical methods of interpreting the motions in the galaxy, spiral nebulæ, and star clusters are developed from a coherent point of view. An American astronomer reviewing this treatise remarked that it should exert a profound influence on the future developments in the field of galactic dynamics. The third monograph by Dr. Chandrasekhar entitled "Stochastic Problems in Physics and Astronomy" was published by the American Physical Society in the *Reviews of Modern Physics*. The analogies which exist between the movements in star clusters and the Brownian movements in colloids are here developed and expounded in an interesting way.

Chandrasekhar is one of that small rare group of men who combine a profound grasp of physical theory and principles, an unrivalled grasp of the methods of mathematical analysis, and a deep and abiding interest in the phenomena presented to us by Nature in the fields of Physics and Astronomy. The names of Newton, Laplace and Einstein spring to the mind when we contemplate the past history of astronomical science and its debt to men who have exhibited this combination of qualities. In the achievements of Chandrasekhar during the past fifteen years, we have at least the promise of a career which should place him in the front rank of the world's great astronomers. The cordial good wishes of all our readers will go out to encourage him in his future activities and to wish him and the talented young Indian lady who shares his home at Yerkes Observatory an uninterrupted welfare and happiness.

GLANDS AND GLAND PRODUCTS

II. The Persulphate Colour Reaction for Adrenaline

BY
B. B. DEY, P. S. KRISHNAN AND V. SRINIVASAN
(Department of Chemistry, Presidency College, Madras)

A RELIABLE and rapid colorimetric method for the estimation of adrenaline which would be applicable not only to pure solutions but also to gland extracts and concentrates had to be chosen in the course of our investigations on the isolation of this hormone from the suprarenal glands of animals. The most popular method for the colorimetric estimation of adrenaline appears to have been the one based on Folin's uric acid reagent, although this method has been subjected to adverse criticism from many quarters. Numerous trials with this and other methods have now been made and our conclusion is that, of the available methods, the most accurate is the one based on oxidation with persulphate or with iodine.

The persulphate colour reaction, discovered by Ewins, was developed by Barker and others[1] into a colorimetric method where the adrenaline content of gland extracts was assayed by treatment of the extract with persulphate reagent at pH 5·4, the maximum colour intensity being evaluated with the aid of a Tintometer and the adrenaline determined by comparison with a standard solution of Adrenaline treated in the same way. Schild[2] first made the interesting observation that the colour development was extremely slow in the case of gland extracts, so that the possibility of direct comparison against standard adrenaline solutions using a colorimeter was practically ruled out. Schild obtained reliable results only by reading off the maximum red tinge with a tintometer. The persulphate colour reaction was also critically examined by Devine[3] who found that ox adrenals developed the maximum colour at the end of 2½ hours while horse adrenals required nearly 6 hours.

TABLE I

Nature of gland	Time for maximum colour development (in hours)	Adrenaline content (mg. per g. of fresh gland)	
		Persulphate method	Iodine method
Cattle	2½	1·82 1·90	1·84 1·90
Sheep	2½	1·56 1·58	1·65 1·68
Pig	2	0·82 0·74	0·90 0·76

TABLE II

Effect of added substances on the time taken for maximum colour development

(a) Substances which do not inhibit development of colour

Nature of Substance	Amount of substance added in mg.	Effect
Trichloracetic acid ..	5–10 mg.	No inhibitory effect
Phenol	0·170 ,,	do.
Resorcinol	0·168 ,,	do.
Glucose	0·210 ,,	do.
Cane sugar	0·126 ,,	do.
Ascorbic acid	0·140 ,,	do.
Uric acid .. .	0·107 ,,	do.
Sodium stearate .	0·230 ,,	do.
Sodium palmitate ..	0·205 ,,	do.
Tartaric acid	0·170 ,,	do.
Tryptophane	0·172 ,,	do.
Arginine hydrochloride ..	0·200 ,,	do.
Glutamic acid	0·200 ,,	do.
Glycine	0·208 ,,	do.
Tyrosine	0·150 ,,	do.
Alanine	0·170 ,,	do.

(b) Substances which inhibit colour development

		Period for maximum colour development (in minutes)
Histidine hydrochloride	0·146 mg.	75
Cystine	(1) 0·09 ,, (2) 0·15 ,,	150 280
Thioglycollic acid ..	(1) 0·12 ,, (2) 0·16 ,, (3) 0·64 ,,	15 25 95
Glutathione ..	(1) 0·038 ,, (2) 0·077 ,, (3) 0·115 ,, (4) 0·192 ,, (5) 0·384 ,,	20 35 55 95 165
Cysteine hydrochloride	(1) 0·029 ,, (2) 0·083 ,, (3) 0·166 ,, (4) 0·332 ,,	40 80 140 270
Trichloroacetic acid extract of pituitary glands	Corresponding to 0·2 g. of fresh glands	45
Blood filtrate (protein-free)	½ c.c.	45

Rees,[4] who confirmed the observations of Schild and Devine regarding the slow development of colour in gland extracts, showed that in spite of this defect reliable results could be obtained using a tintometer by a proper adjustment of pH and temperature.

According to our own experience of this method, the maximum colour intensity with the persulphate reagent under conditions specified by Barker and others (*loc. cit.*) is reached at the end of 2 to 2½ hours in the case of gland extracts (cattle, sheep and pig glands), and in ten to twenty minutes with pure adrenaline solutions. The estimations have, however, been successfully carried out, using an ordinary Duboscq colorimeter for comparing the two colours, by a slight modification of the usual procedure. The colour of the gland extract is allowed to develop first and thirty minutes before the maximum is reached, the time for maximum colour being determined separately in preliminary experiments, the development of the standard colour is started, the comparisons being made at the end of the period. The matching under these conditions is perfect and the results are not only easily reproducible, but also compare very favourably with those obtained by the iodine oxidation method. In the latter method the colour development occurs normally even in the case of gland extracts. The results are illustrated in Table I. Systematic attempts were then made to discover the nature of the particular substance or substances which could be responsible for the retardation of the colour development with the persulphate reagent. As trichloracetic acid extracts of glands were employed, they should be considered to be protein-free. The method adopted was the addition of known amounts of various pure compounds and also tissue extracts to standard adrenaline solutions containing about 0·2 to 0·3 mg. of the free base and determination of the time taken for the maximum development of colour. The results are represented in Table II.

The observation that glutathione and cysteine, both of which contain the sulphydryl group, exert a marked retarding effect on the colour development is very significant in view of the known fact that the adrenals contain the richest concentration of glutathione in the animal body. The interference due to cysteine is rather difficult to explain unless perhaps one assumes that reduction to cysteine is taking place under the conditions of experiment, or that it gets preferentially oxidised Very interesting also is the observation that trichloracetic acid extracts of pituitary glands have a similar effect on the retardation of colour development. It will be recalled that ascorbic acid determinations in this gland, as in the case also of the adrenal glands, by the indophenol titration method yield consistently lower values than by the iodine titration method, thereby indicating the presence of extraneous reducing systems both in the adrenal and the pituitary glands.

The expenses of these investigations were met entirely by a grant from the Board of Scientific and Industrial Research, to whom our grateful thanks are due.

Further investigation is progressing.

---

1. Barker, Eastland and Evers, *Biochem. J.*, 1932, **26**, 2129. 2. Schild, *J. Physiol.*, 1933, **79**, 455. 3. Devine, *Biochem. J.*, 1936, **30**, 1769. 4. Rees, *Quart. J. Pharm.*, 1936, **9**, 659.

NOMENCLATURE OF POSTERIOR FINS OF FISHES

By JNANENDRA LAL BHADURI
(*Zoology Department, University of Calcutta*)

THE term 'ventrals' is well known in ichthyological literature, but, having gained access to text-books, it has become rather confusing to the general students of zoology. It is found that many authors do not hold the same opinion in regard to the proper use of the term. A few random instances from several well-known text-books will show that while some authors[1] use ventral fin and anal fin as synonyms, others[2] use 'ventrals' for the paired pelvic fins. A few authors,[3] however, avoid the use of the term 'ventrals', and write only the unequivocal terms 'pelvics' and 'anals'. Further, reference to Indian ichthyological works[4] will show that 'ventrals' was chiefly, if not exclusively, used as a synonym for 'pelvics'.

Synonymous terms are indeed sometimes confusing, but we know that they are rampant in all literature, and it is by no means easy to repudiate them. Having due regard to comparative anatomy of vertebrates, it is exhorted that 'ventrals' should never be used for 'pelvics', since it is well known that pelvic fins of fishes are paired, and, as such, go to form the pelvic girdle and limbs of tetrapods, and in groups higher than fishes, 'ventrals' is never used in that sense. In the review of Thillayampalam's second edition of *Scoliodon*, Dr. Hora[5] raised this point, but did not resolve it. I invited his attention to the above farraginous use of the term 'ventrals', and Dr. Hora, in a letter (April 1939) kindly replied as follows:—

> "The British Museum ichthyologists use 'pelvic fins' and not 'ventral fins' for the hinder paired fins. I have not paid much attention to these terms so far, but on reading your letter I would be inclined to follow the British Museum people. I think you have made out a very good case for the use of the term pelvic fins. I am further of the opinion that 'ventral fin' should not be used for the anal fin, otherwise there may be some confusion."

I had also received the opinions of four other eminent zoologists, namely, the late Dr. C. Tate Regan, F.R.S., Director, British Museum (*Nat. Hist.*), London, Prof. E. S. Goodrich, F.R.S., of Oxford University, Prof. L. F. de Beaufort, of the Zoological Museum, Amsterdam, and

Dr. E. W. Gudger, Ph.D., Honorary Associate, American Museum of Natural History, New York. I take this opportunity of recording my deep sense of gratefulness to all of them for their cordial and considered expression of opinion. The points on which information was sought of them may be summarised as follows, *viz.*, (*a*) whether the term 'ventrals' should be used as a synonym for either 'pelvics' or 'anals'; if not, should it be retained in the descriptive morphology of fishes; (*b*) what are the etymological and morphological significance of the term 'ventral'? The replies I received from them being informative, I am tempted to quote them *in extenso*.

Dr. Tate Regan wrote on April 25, 1939:—

"The words vent and ventrals are not related. Ventral—pertaining to the belly (Lat. *venter*, belly) as dorsal means pertaining to the back. In descriptive zoology these meanings are somewhat extended, so that dorsal and ventral are equivalent to upper and lower.

"The word ventral might thus be used for any of the lower fins, but I myself, finding it used by some authors for one fin, by others for another, thought it best to give it up altogether, especially as there are names available, pelvic and anal, about which there is no doubt."

Prof. Goodrich wrote on July 20, 1939:—

"The term 'ventral' is derived from the Latin *venter* = belly and is used as opposed to dorsal. Very generally in the older literature the pelvic fins were designated as 'ventrals', but it is a bad term for this purpose and they should certainly be called pelvic fins. So far as I can remember I have always used 'pelvic' myself—though I see that in your letter you put my name among those who have used 'ventral fin' as well. If so it must have been by mistake—a slip of the pen.

"The term 'anal' is correct for the median fin behind the anus.

"Of course both the pelvics and the anals are ventral in a general sense."

Prof. de Beaufort wrote on May 2, 1939:—

" ..... The question is this. The ancient authors called the ventrals 'Pinnæ ventrales' and this has been translated in all languages as 'ventrals' or their synonym. I think it was Regan who pointed out that this name is not correct, as in many fishes the ventrals are not ventral, but thoracic or even jugular. He, therefore, used the name 'pelvics'. I think this is a better neutral name, but I am too old-fashioned to change my habits and I still use 'ventrals'. The principal reason is, that in the work edited by me and the late Prof. Max Weber, we used the term 'ventrals' from the beginning and it is difficult to change to another name in following volumes. I hope to have answered your question satisfactorily and if you will have my advice I should say, use the term pelvics."

Dr. Gudger wrote on May 5, 1939:—

"The question raised in your letter of April 13th is one that I have raised very frequently in discussion with ichthyologists. We agree and so do the comparative anatomists that the anterior paired fins of a fish should be called pectorals, being directly homologs with the pectoral arch and anterior limbs of the higher vertebrates.

"Unfortunately there is great discrepancy with regard to the posterior girdle and fins. The comparative anatomists, of whom the late James S. Kingsley is one, have always contended so far as I know that the posterior girdle and fin should be called pelvic. This is logical since they are the homologs of the hinder girdle and limbs of the higher vertebrates.

"This is the practice of the Cambridge Natural History, of J. Graham Kerr in his text-book of embryology, and many other men. The new Webster International Dictionary, second edition, uses pectoral and pelvic fins. I was editor for the ichthyological terms of this second revisal and I saw to it that this usage was made in the dictionary.

"The fin or fins on the back of a fish are, of course, plainly called dorsals. The fin at the vent is and probably correctly called anal but this is certainly an anomaly with the second fin of this kind, as in the codfish, when it is called the second anal in the books. Probably it would be better usage to call both these fins ventrals but anal is well established and if ichthyologists can be persuaded to call the hinder paired fins pelvics, then it might be possible to designate this second so called anal in codfish as a ventral fin. The trouble about calling these two unpaired fins ventrals is that neither one of them is on the venter or belly.

"The long and short of the matter is that the hinder girdle and paired fins should be called pelvic. We are there on solid morphological grounds.

"I hope that this dissertation may be of some value to you."

It will be seen from the above that there is no division of opinion in discarding the term 'ventrals' in favour of 'pelvics'; even Prof. de Beaufort endorses the same view, although he himself is unable to follow it up for reasons best stated in his letter. But, from the recent writings of Dr. Hora,[6] it will be noticed that although he is not desirous of using 'ventrals', he occasionally employs both the terms 'ventrals' and 'pelvics' in a synonymous sense.

Apropos of the ventrals being used as a synonym for the 'anals', there seems to be some difference of opinion. Prof. de Beaufort does not appear to have written anything about this, while Prof. Goodrich's last statement expresses that the term 'ventrals' may be retained in a general sense for both 'pelvics' and 'anals'. On the other hand, Dr. Gudger seems to be somewhat dubious about this point, and cannot arrive at a definite conclusion. Dr. Regan is, however, very clear about this issue, since he has long steered clear of 'ventrals'. Dr. Hora is also of the same opinion. I am not aware of what other ichthyologists think about these contentions.

Attention may also be drawn, in this connection, to another fact which Dr. Hora has kindly pointed out to me. It is the usual prac-

tice with the ichthyological systematists to write the fin-formula as 'D.P.V.A.C.', where 'V' stands presumably for 'ventrals'. Those who have discarded the term 'ventrals', retain, however, the symbol 'V.' for pelvics in the fin-formula. Systematists should also ponder over this abbreviation.

In fine, I am inclined to follow Regan's views and ask for a complete banishment of the term 'ventrals' from the description of ichthyological morphology, notwithstanding that this term has found frequent currency since the dawn of ichthyological science down to this day. It is hoped, and urged, that ichthyologists should give a unanimous verdict on the stringent use of the term 'ventrals' so that text-book authors may give currency to a correct and unconfounding term for the profit of general students of zoology.

---

1. Bourne, G. C., *Comp. Anat. Animals*, 1922, **2**, 206–7; Wiedersheim, R., and Parker, W. H., *Comp. Anat. Vertebrates*, 1907, p. 136; Thillayampalam, E. M., *Scoliodon*, 1938, p. 16; Thomson, J. A., *Outlines of Zoology*, 1929, p. 631; de Beer, G. R., *Vertebrate Zoology*, 1932, p. 80; Newman, H. H., *The Phylum Chordata*, 1939, p. 148; Wheeler, W. F., *Text-book of Zoology*, 1938, p. 109; Walter, H. E., *Biology of the Vertebrates*, 1939, pp. 600, 617; Parker, T. J., and Haswell, W. A., *Text-book of Zoology*, 1940, **2**, 238; Hyman, L. H., *Lab. Manual for Comp. Vert. Anat.*, 1940, p. 20. 2. Günther, A. C. L. G., *An Intr. to the Study of Fishes*, 1880, p. 42; Nicholson, H. A., *A Manual of Zoology*, 1887, p. 634; Jordan, D. S., *Fishes*, 1925, p. 23; Kingsley, J. S., *The Vertebrate Skeleton*, 1925, p. 227; Sedgwick, A.,* *A Student's Text book of Zoology*, 1905, **2**, 185; Goodrich, E. S.,* *Studies on the Structure and Development of Vertebrates*, 1930, p. 123; Wolcott, R. H., *Animal Biology*, 1940, p. 354; Innes, W. T., *Exotic Aquarium Fishes*, 1938, p. 84. 3. Dakin, W. J., *The Elements of Biology*, 1934, p. 177; Kerr, J. G., *Zoology for Medical Students*, 1921, p. 294; Chidester, F. E., *Zoology*, 1933, p. 252. 4. Day, F., *Fauna Brit. India*, 1889 and *Fishes of India*, 1878–88; Annandale, N., Chowdhury, B. L., Hora, S. L., and others, *Rec. Ind. Mus.*, 1910–38. 5. *Curr. Sci.*, 1939, **8**, 135. 6. *Rec. Ind. Mus*, 1940–42.

* The authors point out either in parentheses or in footnotes as 'often or usually called ventrals', otherwise they use 'pelvics' exclusively.

RAO BAHADUR K. N. DIKSHIT, M.A. F.R.A.S.B.

RAO BAHADUR K. N. DIKSHIT who will be retiring shortly from the post of Director-General of Archæology in India was appointed to that post in 1937. Before he became Director-General, he had gained wide experience in various capacities as Superintendent of Archæology in the Indian Museum and in several provinces, as Government Epigraphist, and as Deputy Director-General. He was one of Sir John Marshall's collaborators in the well-khown excavations at Mohenjo-daro. His contributions in the field of epigraphy, numismatics, ancient Indian art, etc., are well known and too numerous to be referred to here (for details *see* O.C. Gangoly, *Modern Review*, February, 1944, pp. 124-126). Few of the readers of *Current Science* would have missed his popular papers, such as *The Outlines of Archæology* or *The Progress of Archæology in India during the last 25 years* (both published by the Indian Science Congress Association, 1938) or his Sir William Meyer Lectures on the Prehistoric Civilization of the Indus Valley. The Paharpur mounds in E. Bengal which he excavated brought to light one of the most important and large-sized temples decorated with numerous terracotta plaques of the Gupta and medieval periods. For the last three years Mr. Dikshit has been concentrating attention on the excavations at Ahicchatra in Bareilly District (U.P.), where discoveries of fundamental importance have been made, particularly of pottery, that will help in establishing the relative chronological sequence for most North Indian historical sites. The large-sized terracotta plaques found at Ahicchatra, with those of Paharpur, have revealed a new school of art in burnt clay.

Rao Bahadur Dikshit has done yeoman service to Archæology in India in several directions by helping and encouraging archæologists in Indian States and the Provinces. He revived the system of Archæological scholarships under the Government of India and induced Indian States to institute similar scholarships, and helped the starting of such organizations as the Kannada Research Society at Dharwar and the prehistoric research expedition in Gujarat. In fact he was indefatigable in his attempts to extend archæological knowledge, the veriest novice finding in him a sympathetic and helpful friend. The Archæological Society of South India received the warmest support from him. By stimulating the free exchange and distribution of antiquities between the museums under the control of the Central Government on the one hand and Provincial Governments on the other, Rao Bahadur Dikshit helped to break the provincialism that always threatens to invade Museums, and there is no exaggeration in stating categorically that there are no Indian museums that have not directly or indirectly benefited by his interest in the Museum movement. Extremely genial in temperament and by nature a good miker, Rao Bahadur Dikshit has been popular everywhere, no matter whether it was a meeting of the Indian Science Congress, the Oriental Conference, the Indian Historical Congress, etc., or an excavation camp; he always attracted men to him. His numerous friends in India and abroad would wish Rao Bahadur Dikshit rest and respite from the "spade", and administrative duties but they will continue to be keen on having more from his mature and scholarly pen. He has still both physical and mental vigour which would, we hope, be long available in the service of the subject for which he has already done much.

LETTERS TO THE EDITOR

DIRECT DERIVATION OF BALMER SPECTRA

Bohr's attractive planetary model, and the simplicity of his derivation of the Balmer series still hold a place in theoretical physics, in spite of the palpable contradictions of the model, differences from fine-structure experimental work, and later theoretical discoveries. It would seem worth while to attempt a direct approach to the problem.

The mechanism by which the electron absorbs the energy of a photon or emits a photon of energy is not satisfactorily explained. But it is generally taken for granted that electromagnetic phenomena are governed by the Lorentz group, so that energy has to be measured by the relativistic formula

$$E=\mu/\sqrt{(1-v^2/c^2)}.$$

On the other hand, electrons in thermionic or in photo-electric emission are assigned the usual Newtonian mass-energy $mv^2/2$, m being the mass, and v the same velocity as in the other formula. This is considered necessary in view of the fact that the emitted electrons seem to follow the Maxwellian (normal) velocity distribution. In what follows, I work out the consequences of this double interpretation of energy and show that the Balmer series formula is an immediate consequence.

The basic formula used will have to be

$$E=h\nu-P=\frac{h\,[n-p]}{2\pi},\ (n \text{ an integer}), \tag{1}$$

where ν is the frequency in *sec.*$^{-1}$, of the exciter wave which has the formula, say, $A \sin nt$, h being Planck's constant as usual and P the *Austrittsarbeit* term supplied by Einstein; instead of restricting it to a metallic surface, however, we shall have to assume that the term accounts for a certain amount of energy which disappears at the surface of any system, even an atomic one, in photo-electric interaction.

The next step is to assume that this is absorbed according to the Lorentz-Einstein law, *i.e.*,

$$\frac{h\,[n-p]}{2\pi}=\frac{\mu}{\sqrt{1-v^2/c^2}}, \tag{2}$$

where μ is an unspecified constant of the absorbing system. This gives at once,

$$v^2=c^2-\frac{4\pi^2\mu^2c^2}{h^2\,(n-p)^2} \text{ whence}$$

$$\frac{mv^2}{2}=\frac{mc^2}{2}-\frac{2\pi^2m\mu^2c^2}{h^2\,(n-p)^2} \tag{3}$$

This $mv^2/2$ term, with m the mass of the electron, will now be assumed to account for the energy between levels, so that if a wave is emitted with the frequency ν, then $h\nu$ will be the energy difference; that is,

$$h\nu=\frac{2\pi^2m\mu^2c^2}{h^2c}\left\{\frac{1}{(n_1-p_1)^2}-\frac{1}{(n_2-p_2)^2}\right\};$$

$$\nu=\frac{2\pi^2m\mu^2c}{h^3}\left\{\frac{1}{(n_1-p_1)^2}-\frac{1}{(n_2-p_2)^2}\right\}, \tag{4}$$

where the extra divisor c (= velocity of light) has appeared on the right because we assume this frequency ν to be measured, as usual in spectrometry, in *cm.*$^{-1}$, and not *sec.*$^{-1}$. It remains only to note that we get the usual Rydberg constant on the right if we identify the coefficient μ with ze^2/c, where e is the

charge of the electron, and z the factor for nuclear charge. Thus, the Balmer formula is derivable as a property of Planck's law, and the ambivalent measurement of energy, without any assumption as to the planetary structure of the atom. In addition, we get the fine-structure terms without further trouble. On the other hand, an assumption of some sort will have to be made about atomic structure or its field of probabilities, in order to derive the intensities.

Fergusson College,
Poona 4, D. D. KOSAMBI.
March 3, 1944.

STRUCTURE OF THE SECOND SPARK SPECTRUM OF BROMINE—BR III

QUARTET and Doublet terms of Br III were reported in a previous communication.[1] A further investigation of the spectrum has led to the identification of many intercombination lines in the ordinary optical and vacuum grating region. The interval between the deep terms $4p\ ^4S_{3/2}$ and $4p\ ^2D_{3/2}$ is found to be 15042 units and that between $4p\ ^2D_{5/2}$ and $4p\ ^2P_{1/2}$ is 10613. The ratio between the intervals is in agreement with the theoretical value. A full report of the extension of the scheme of terms will be published elsewhere.

Andhra University,
Guntur, K. R. RAO.
February 18, 1944.

1. Rao and Krishnamurty, *Proc. Roy. Soc.* (Lond.), 1937, **161**, 38.

THERMAL REPULSION

DURING the last few years numerous contributions,[1,2,3,4,5] have been made to this subject from the laboratories of the Meteorological Office at Poona. It was shown[4,5] that, under the ideal conditions when convective movements are eliminated in an air-cell by bringing the plane hot surface sufficiently close to the plane cold surface, the thermal repulsion of objects like dust particles, oil droplets or a mica vane (suspended vertically by quartz fibre and at right angles to the temperature gradient) may be observed as a simple force acting in the direction of the thermal gradient towards the cold surface. Under the above circumstances, the thermal force is not affected by the disturbing influence of convection. A reference to the figures in Plate XI of Paranjape's paper[4] will show the simplicity of the phenomenon when convection is eliminated.

Fig. 1 shows the apparatus devised by Ramdas and Joglekar[5] for measuring the force due to thermal repulsion. A temperature gradient is maintained between the faces GH and KL of the vessels A and B which are kept at the desired temperature by circulating hot and cold water respectively through the tubes C_1, C_2 and C_3, C_4. T_1 and T_2 are thermometers. The vessels A and B slide in the outer piece CEFD so that the distance between GH and KL may be adjusted as desired. The joints at C, D, E and F can be made air-tight by means of a mixture of bees-wax and rosin. The mica piece M is suspended by means of a fine

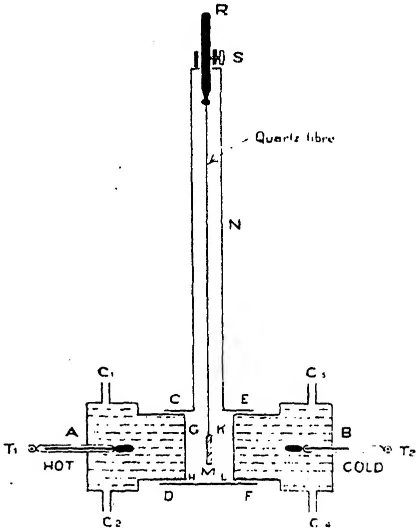


FIG. 1.

quartz fibre as shown. As soon as the face GH becomes warmer than KL, M is deflected to the right, the deflection being proportional to the thermal gradient. The deflections are measured by means of a microscope focussed on the lower end of the quartz fibre and having a suitable graticule in the eye-piece.

At the suggestion of Dr. Ramdas, the present writer undertook the investigation of the effect of the pressure of the gas on thermal repulsion. The range of pressure was from 1 atmosphere down to the lowest pressure which it was possible to obtain with a high-vac pump in series with a pair of Waran's mercury diffusion pumps, with the necessary traps to eliminate water vapour. The low pressures were measured by a Mac-Leod gauge and the higher pressures directly with the aid of a travelling microscope and a mercury manometer.

It is found that the thermal repulsion pressure F ($F = mg\theta$ where m is the mass per unit area of M the mica-piece, θ is the angular displacement from the vertical in radian measure and g is the acceleration due to gravity) is found to increase only slightly on reducing the pressure in the apparatus from 71 cm. to 1 cm. of Hg. The most interesting variations occur as the pressure is reduced below 1 cm. There is at first a gradual and later a very rapid increase in the thermal force. For an air gap of 2·5 mm. and a temperature difference of 2·5° C. between the walls (under the ideal conditions referred to at the beginning of this note, relatively small temperature gradients are indeed sufficient to produce sensible effects) the thermal force for a temperature difference of 1° C. attains a maximum value of the order of 0·027 dyne per sq. cm., when the pressure is about 10^{-2} cm. of Hg. As the pressure is reduced further the thermal force decreases rapidly. Fig. 2 shows the general nature of the results obtained. It may be pointed out that the portion BC of the curve

represents conditions corresponding to the "Knudsen manometer action" which is utilised for low pressure measurements (Pirani

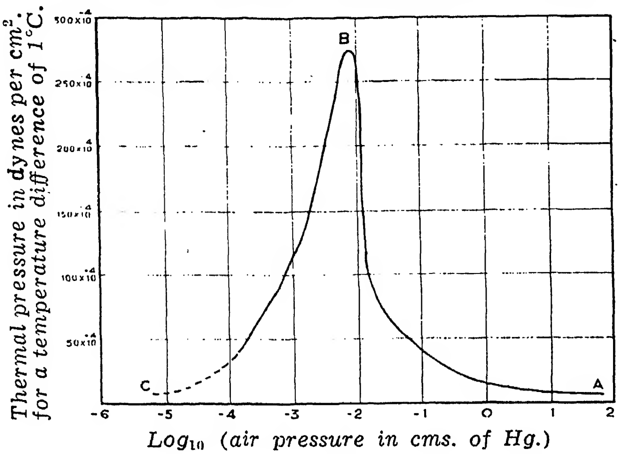


FIG. 2

Gauge*). Curves somewhat resembling Fig. 2 were obtained by G. D. West[6] but his experimental arrangements and results were complicated by the use of rather large-sized air-cells and of radiation as the source of heating.

The whole subject is now under active investigation for different air-gaps, temperature gradients and gases. A full discussion of the results, both experimental and theoretical, will be presented in a forthcoming paper.

The writer is grateful to Dr. L. A. Ramdas, Agricultural Meteorologist, for suggesting the problem and for guidance. Thanks are also due to the Director-General of Observatories for permission to work in the laboratories of the Meteorological Office at Poona.

Meteorological Office,
Poona,
February 18, 1944.

M. K. PARANJAPE.
Lecturer in Physics,
Sir Parasuram Bhau College.

1. Ramdas, L. A., and Malurkar, S. L., *Ind. Journal of Physics*, 1932, **1**, 1. 2. —, *Nature*, February, 1932, **6**, 201. 3. Ramdas, L. A., *The Journal of the University of Bombay*, Sept. 1937, **6**, Pt. II, 18. 4. Paranjape, M. K., *Proc. of the Ind. Academy of Sciences*, 1936, **4A**, 4, 423. 5. Ramdas, L. A., and Joglekar, S. Y., *Ibid.*, 1941, **13**, No. 5, Sec. A. 6. West, G. D., *Proc. Phys. Soc.*, London, 1920–21, **33**, 266.

* See also a paper by Lockenvitz; *Review of Scientific Instruments*, 1938, **9**.

HUMID FATIGUE OF HYGROMETERS

Now, while finding the time lag of Mahajan's optical hygrometer,* it is observed that this hygrometer when treated for a number of times with moist and dry currents of air alternately (without any break in the cycle of observations) has less time lag than otherwise. The hygrometer which has been so treated comes to rest and gives a constant value in a shorter time than otherwise. Thus the time lag of hygrometer depends upon its immediate past history, besides other factors.

The effect of the immediate past history is found in other types of hygrometers also. This phenomenon may be called the Humid Fatigue of hygrometers.

A set of observations recorded for some of the hygrometers is given in Table I below.

TABLE I

Kind of hygrometer	No. of observations	I cycle		II cycle		Remarks
		Increase of humidity	Decrease of humidity	Increase of humidity	Decrease of humidity	
1	2	3	4	5	6	7
Mahajan's Optical Hygrometer	1st set	22 min.	37 min.	21 min.	34 min.	All sets taken on different days & times
	2nd ,,	20 ,,	38 ,,	15 ,,	30 ,,	
	3rd ,,	18 ,,	34 ,,	11 ,,	23 ,,	
	Mean	20 ,,	36 ,,	16 ,,	29 ,,	
Hair Hygrometer	1st set	20 min.	40 min.	17 min.	29 min.	do.
	2nd ,,	17 ,,	39 ,,	16 ,,	27 ,,	,,
	3rd ,,	18 ,,	38 ,,	15 ,,	25 ,,	,,
	Mean	18 ,,	39 ,,	16 ,,	27 ,,	
Paper Hygrometer	1st set	35 min.	45 min.	22 min.	32 min.	do
	2nd ,,	29 ,,	43 ,,	25 ,,	39 ,,	,,
	3rd ,,	34 ,,	48 ,,	21 ,,	35 ,,	,,
	Mean	33 ,,	45 ,,	23 ,,	35 ,,	

In the above table, column No. 3 gives time lag when hygrometer is treated with a current of moist air, and column No. 4 represents time lag when it is merely exposed to dry air of the room (hence longer time lag in the latter case). Then just after this, the second cycle of action is repeated in the same way, and its observations are recorded in columns Nos. 5 and 6. This data clearly indicates that the time lags in the second cycle are less than corresponding time lags in the first cycle.

Physics Research Laboratory,
Mahendra College,
Patiala, L. D. MAHAJAN.
November 18, 1943.

* L. D. Mahajan, "An Optical Hygrometer", *Current Science*, Bangalore, **1941**, **9**, **2**, 100, February. L. D. Mahajan, "The Optical Hygrometer and its Working," *Indian Journal of Physics*, Calcutta, Dec. **1941**, **15**, **6**, 425–32.

CENTRAL HIMALAYAN GEOLOGY A REPLY

In a communication to the November 1943 issue of the *Current Science*, Mr. J. B. Auden raised certain questions on my recent paper on the correlation of Simla rock formations. He feels that my conclusions, based on the field study of the Sirmoor Himalayas, should not have been extended to other areas. I have only to state in this connection that the large-scale structural features in these tectonic mountains are not strictly local but have a much wider extent and may be found repeated in adjoining parts.

1. The first point raised by Mr. Auden is regarding the correlation of the Bansa Limestone with the Krols. In a table of several analyses he has tried to show that the differences are profound and as such the correlation is untenable. A perusal of the table would, however, show that the differences are not as profound as suggested but are quite within the limits of variations both lateral as well as vertical in any sedimentary formation. Moreover the differences between the Lower Krol and the Upper Krol limestones are much greater than those between the Lower Krol and the Bansa but this does not vitiate the inclusion of the former two into one Krol formation. The more important consideration in these correlations is the nature of the associated rocks which in the case of the Bansa limestone, are indistinguishable from the Simlas and the Infra Krols.

2. Regarding the nature of the Blaini boulder bed Auden states that the bed constantly occurs at a certain horizon in the Krol belt and can be traced for over 120 miles, hence has stratigraphic importance, but he omits to mention that it also occurs extensively outside this belt in association with rocks which are not members of the Krol sequence. Auden himself is not satisfied with the present conception regarding the mode of formation of this boulder bed but has failed to suggest any alternative mode. Regarding the position of the bed in my sections in the above paper I have indicated it by a line of thick dashes in Figs. 1-3 between the Infra Krols or Simlas and the Jaunsars.

Regarding the nature of the purple sandstone boulders observed in the Blaini bed their Dagshai character was recognised not by me but by officers of the G.S.I. I wonder what positive evidence Auden has to assert that they are not Dagshai but Simla or Nagthat.

3 (*a*) Regarding the occurrence of Nummulitics between the schistose rocks and Upper Tals the reference quoted by Auden is not quite clear or suggestive. But if that be true it may only indicate that the Jutogh Thrust was older than the Eocene and over a part of which, Nummulitics were deposited, and later rethrusted.

(*b*) The fossiliferous limestone ascribed to Upper Tal may after all be Nummulitic and not Tal.

(*c*) Current bedding is a dubious structural feature in tectonically disturbed rocks and may not be due to the particular mode of sedimentation. This would not, further, prove the uninverted nature of the Upper Tal quartzites. Moreover, I have never asserted that they are inverted.

(*d*) The lithological gradation between 'Tal' shales and quartzites is more apparent than real and no process of sedimentation can bring about the deposition of hard quartzites over soft shales. Selective silicification or metamorphism of quartzites to the exclusion of shales is also inexplicable. Only thrust movements can bring about superposition of highly metamorphosed rocks over unmetamorphosed ones.

(*e*) I have seen the 'Tal' quartzites of the Koti-Dhaman area and they are highly metamorphosed. I fail to understand how Auden regards them as unmetamorphosed.

(*f*) I have not seen any remarkable lithological differences between the Tal and the Jutogh quartzites.

4. Lastly, Auden refers to the intrusive nature of Chor Granite. Along with previous workers Auden maintains that it is intrusive *in situ* into the Schists inducing contact effects on associated Palæozoic sediments. The Chor granite is everywhere surrounded by Jutogh quartzites and schists which are a highly metamorphosed set of rocks whether in the vicinity of the granite or away from it. The metamorphic effects are wholely of dynamothermal nature and show no characteristics of contact metamorphism. The inclusions of angular fragments of schists within the granite mass show not the least signs of resorption or even baking. Bands of dolomitic marble along the granite periphery are similarly unaffected. On the other hand the junction of granite with Jutoghs is marked by extreme foliation and brecciation the quartz porphyry being converted into papery schist and laminæ. Granite mass itself has assumed a gneissose structure which diminishes rather rapidly as we move away from the junction. This junction is also marked by an abundance of pegmatite and dolerite dikes. All these indicate clearly that the junction is a thrust plane along which there has been an appreciable movement of the granite mass over the Jutoghs.

It is quite possible that initially in the autochthonous regions the granites were intrusive into the Jutoghs, but they appear definitely

older than the Jaunsar-Simla formations. In the nappe zone, however, they are either thrusted over the Jutogh's or they form cores of the Jutogh folds.

In the end I have to state that my conclusions were based on the study of the Sirmoor Hills to which they are largely applicable. The extension of these views to areas outside Sirmoor is merely suggested as a possibility in view of the fact that these tectonic features are generally regional and not strictly local. Only a detailed study of any area in the light of these considerations would prove their applicability or otherwise to that area.

Department of Geology,
Andhra University,
Guntur, K. P. Rode.
January 17, 1944.

ALGAL STRUCTURES FROM THE CUDDUPAH LIMESTONES (PRE-CAMBRIAN), S. INDIA

With reference to the note published on this subject in the July number of *Current Science*, I should like at the very outset to correct the impression conveyed in the second para of that note, that Professor Sahni has "agreed that the structures referred to above are of plant origin". Professor Sahni's view in the matter is that "While it is possible that some of the concretion-like growths are due to *plant activity*, there is no evidence whatever of plant structure. I include here what you refer to as algal dust".

Since publishing the note the material has been further investigated and many more sections of this limestone showing these structures

Fig. 1. Algal nodule (*cf. Cryptozoon.*) from Royalcheruvu. ×¾ (ca).

have been cut and examined. More recently I have also visited the area near Royalcheruvu, Ananthapur District, and have now been able to collect specimens of limestones showing structures remarkably similar to those described under the name 'Cryptozoon proliferum' by C. L. and M. A. Fenton,[1] from the Upper Cambrian of Pennsylvania. The rock frequently shows a number of columnar bodies of calcium carbonate tapering at one end, occurring either as free individuals or in groups when they are fused together at the bottom by horizontal or curved extensions, suggesting a colonial habit. They vary from about 1 to 2½ inches in diameter, and in a transverse view, on a polished surface of the rock, numerous irregularly concentric lines of growth can be seen; and the whole structure reveals characteristic porcellanoidal patches suggestive of algal origin. When examined under the microscope, these patches are seen to consist of aggregates of minutely crystalline calcite always having a different degree of crystallinity from the rest of the rock, and presenting a dark dusky appearance in reflected light strikingly similar to the 'algal dust' described and figured by Alan Wood[2] from the Carboniferous of England.

While it is true that definite recognisable plant-cell structures as such, have not been so far noticed, all other evidences, however, compel the author to believe that these structures are of organic origin and referable to algal activity. A full description of these structures is under preparation and will be published as early as possible.

Department of Geology,
Central College,
Bangalore, M. R. Srinivasa Rao.
February 8, 1944.

1. C. L. and M. A. Fenton, *American Midland Naturalist*, 1937, **18**, 435. 2. Alan Wood, *Geol. Mag.*, **1941**, **78**, 192.

MICROBIOLOGICAL ASSAY FOR PANTOTHENIC ACID

Since the discovery that the chick antidermatitis factor[1] is identical with pantothenic acid,[2,3] attempts have been made to estimate this vitamin in different biological materials. The two methods commonly used are (*a*) the chick growth method[4] and (*b*) the microbiological method employing *Lactobecillus caseie*[5-8] and *Proteus morganii*[9] as the test organisms. In a previous paper[10] pantothenic acid was shown to be essential for the growth of *Lactobacellus bulgaricus*. It was felt to be of interest to discover whether this organism could be used as a test organism for the assay of pantothenic acid.

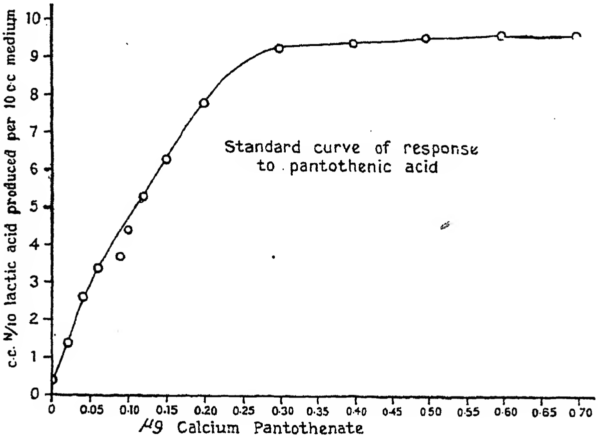
The basal medium, inoculation and the assay procedure were essentially the same as those described by Pennington *et al.*[6] The growth response of *L. bulgaricus* to different concentrations of calcium pantothenate (0·02–0·70 μg. per 10 c.c. medium), as determined by the amount of lactic acid formed in 72 hours at 37° C., is shown in the figure.

The values shown in the figure could be satisfactorily reproduced within a wide range (0·01–0·15 μg. Ca pantothenate). The curve is linear, thereby indicating the suitability of this organism for the assay of pantothenic acid.

The pantothenic acid content of samples of dried yeast, yeast extracts and animal tissues was estimated using *L. bulgaricus*. The samples, after 48 hours autolysis, were autoclaved and the extracts *thus* obtained were used at two levels for the assay. The results are presented in the table.

The reliability of the response of *L. bulgaricus* as a measure of pantothenic acid is sup-

ported by the facts that (*a*) the results calculated from two different levels agreed satisfactorily, (*b*) pantothenic acid added both to



Pantothenic Acid Content of Yeast, Yeast Extracts and Animal Tissues

	Weight of test sample added to basal medium (mgs.)	μg. Ca pantothenate per gm.		% Recovery of added pantothenate	
Brewer's yeast, dried	0·4	130	133	90	90
	0·8	136		90	
Torula yeast, dried	0·4	84	84	86·7	88·4
	0·8	84		90·0	
Yeast extract (1)	0·2	290	295	107·0	103·5
	0·4	300		100·0	
,, ,, (2)	0·2	280	282·5	—	
	0·4	285		100·0	
Alkali-treated yeast extract	0·4	0		100·0	100
	0·8	0		100·0	
Ox liver	0·4	60·0	59·5	90·0	90·0
	0·8	58·8		90·0	
Sheep kidney	0·4	26·0	28·0	90·0	
	0·8	30·0			
Sheep heart	0·4	16·0	14·5	82·0	
	0·8	13·0			

intact materials and materials in which pantothenic acid was destroyed by autoclaving with strong alkali was satisfactorily recovered, and (*c*) the values obtained are in good agreement with those reported by other workers for yeast, yeast extracts[11] and animal tissues.[12]

The method is now being extended for the estimation of pantothenic acid in other biological materials. The organism employed in this investigation was obtained from The National Collection of Type Cultures, India, Indian Institute of Science, Bangalore, to whom my thanks are due.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor, KAMALA BHAGVAT.
February 8, 1944.

1. Woolley, Waisman and Elvehjem, *J. Biol. Chem.*, **1939**, **129**, 673. 2. Jukes, *J. Amer. Chem. Soc.*, 1939, **61**, 975. 3. Snell, Strong and Peterson, *J. Bact.*, 1939, **38**, 293. 4. Jukes, *J. Nutrition*. 1941, **21**, 193. 5. Pennington, Snell and Williams, *J. Biol. Chem.*, 1940, **135**, 213. 6. Pennington, Snell, Mitchell, McMahan and Williams, *Univer. Texas Publ. No. 4137*, 1941, **14**. 7. Strong, Feeney and Earle, *Ind. Eng. Chem.*, Anal. Ed., 1941, **13**, 566. 8. Landy and Dicken, *J. Lab. Clin. Med.*, 1942, **27**, 1086. 9. Pelczar and Porter, *J. Biol. Chem.*, 1941, **139**, 111. 10. Bhagvat and Sekhon, *Curr. Sci.*, 1944, **13**, 45. 11. Willerton and Cromwell, *Ind. Eng. Chem.*, Anal. Ed., 1942, **14**, 603. 12. Waisman, Henderson, McIntire and Elvehjem, *J. Nutrition*, 1942, **23**, 239.

FREEZING TEST FOR DETECTING ADULTERATION IN EDIBLE OILS

SESAME and mustard oils are generally used in this country as fat foods. To a limited degree coconut oil and nigerseed oil (kurdi oil) find popularity in certain parts of the country. Groundnut and other oils from vegetable sources such as sunflower oil, etc., are used only as adulterants for the above class. Detection of adulterations in market samples of sesame and mustard oils with the said common adulterants is a matter of considerable difficulty to the Public Analyst. The procedures leading to detection of such adulterations are tedious and require a well-equipped and staffed laboratory. In a case like the admixture of sesame oil with kurdi or kursani oil, detection is extremely difficult if not impossible in that the 'analytical constants' have the same ranges. Further the present methods detect adulteration and quantitative estimation of the components are considered far from being satisfactory. The public have no easy means to judge for themselves the market samples prior to purchase.

A few observations made by the author in the course of his work would throw some light on the question. Fresh or aged samples of genuine sesame oil and mustard oil retain their liquid consistency when cooled to the temperature of ice, whereas groundnut oil and nigerseed oil freeze to ghee-like solid at the said temperature. Mixtures of the two groups will likewise solidify at zero degree Centigrade, with this important difference that depending on the quantities of the adulterants the time taken to freeze varies. Thus it is found that if groundnut oil forms only 5 per cent. of the mixture, freezing to solid occurs in 14 hours, whereas with this component in 30 per cent. and above, brings about the same change in half an hour. In the case of nigerseed oil, for the detection of which there appears to be no method at present, freezing takes place only when it is in more than 30 per cent. in admixture. Since the procedure needs no chemicals or scientific apparatus, the test is considered very handy for the public as well as the Public Analyst.

The test itself may be performed by taking as much as a quarter ounce of the oil in a glass bottle, preferably thin-walled and kept surrounded in a container with ice broken into small fragments. If solidification takes place in less than an hour's time, it can be taken to mean that the sample is not only adulterated but that the adulterant is groundnut oil which constitutes at least 30 per cent. It is considered that the method may be improved to yield quantitative results.

Surat, G. NARASIMHAMURTHY.
January 1943.

HISTOPATHOLOGY OF NECROTIC MANGO FRUIT

In course of the investigation on the histopathological changes that occur in necrotic mango fruits certain deposits were observed in the xylem and in the ducts of the preserved diseased fruits which seemed to be casually related to the incidence of the disease.

The investigation has so far been confined to six varieties of mango fruits comprising Dashehri, Safeda, Langra, Bombai, Gola and Gola khepta, collected from various diseased and healthy orchards of Lucknow, Rampur, Fatehgarh, Mainpuri and Hardoi districts along with similar fruits from an orchard in Lucknow where experiments were carried out to initiate necrosis by fumigation by burning coal.

The mangoes utilized were healthy fruits from healthy orchards, apparently healthy fruits from heavily diseased orchards, and fruits showing different developmental stages of necrosis, both in fresh condition and those preserved for different lengths of time ranging from one day to four years in form-acetic-alcohol, 90 and 70 per cent. alcohol and 4 per cent. formalin.

The technique employed were those of serial section and maceration of the tissues by means of weak solution of alkali. The maceration method by which the xylem and duct systems of the fruits could be easily traced and examined yielded better results.

Fresh healthy fruits from healthy orchards have not revealed the presence of deposits. Neither have any deposits been observed in preserved healthy fruits from healthy orchards. Apparently healthy fruits without the slightest external symptom of the disease but gathered from diseased orchards contain deposits to some extent.

The unpreserved (fresh) diseased fruits showing early stages of necrosis show deposits only in rare cases. But in mangoes showing later stages of necrosis where tissues have collapsed and disintegrated deposits are found in large quantities in the necrotic region and in ducts and vessels slightly above that region. Further beyond they seem to be free.

Preserved diseased fruits show copious deposits both in ducts and xylem elements. In vessels maximum amount of deposits (usually viscous) are found at the stalk end of the fruits most of which are completely plugged (Fig. 1). Vessels ramifying to other parts of the fruit contain deposits to a lesser degree some of which are also choked.

In ducts the deposits are particularly heavy (Fig. 2) and are present all along the system. These deposits are not continuous but are found as smaller or bigger solid or viscous masses scattered throughout the duct system.

Experiments in which the diseased fruits had been preserved in form-acetic-alcohol and 4 per cent. formalin for different lengths of time showed that the deposits become discernible on or about the seventh day. In the early period of preservation the colour of the deposits is light yellow which gradually changes into bright red as the length of preservation increases.

From a preliminary study of the chemical nature of the deposits it appears that they

FIG. 1. Showing xylem vessel completely choked.

FIG. 2. Showing deposits (D) in the ducts and xylem (x) running along with the ducts.

belong to the group of phlobatannins comparable to the deposits discovered by Dastur[1] in cotton plants in the Punjab.

It is not unlikely that in normal fruits the tannins which are formed are used up by the fruit itself. But when there are some metabolic disturbances due either to the changes in atmospheric conditions caused by fumes emanating from a brick kiln or due to other factors such as deficiency of an important element, these tannins are stored up in fruits in the form of an unutilisable tannin compound. This substance, which is probably present in a semi-solid and hyaline condition, cannot be detected without preservation. The appearance of the coloured deposits in the ducts and xylem of healthy parts of diseased fruits under preservation, however, indicates that these were present in the system and became distinguishable only when acted upon by the chemicals present in the preservatives.

The appearance of deposit is the first internal index of the disease long before the ætiolation at the distal end becomes externally visible. As the deposits increase the vessels become clogged and the supply to the distal end of the fruit is partially cut off and the disease starts. From the distribution of deposits in the ducts it seems that the deposits are translocated to the distal end where they accumulate and eventually burst the tissues. Thus the lack of supply, accumulation of deposits and consequent metabolic and histological changes bring about the diseased condition in the mango fruit.

The detailed work on the subject will be shortly published.

Botany Department,
University of Lucknow, S. N. DAS GUPTA.
December 21, 1943. S. N. ASTHANA.

1. Dastur, R. H., *Ind. Jour. Agri. Sc.*, 1941, **11**, part II.

INVESTIGATION OF PHOTOCHEMICAL AFTER-EFFECT: THE DECOMPOSITION OF HYDROGEN PEROXIDE BY POTASSIUM FERRICYANIDE

In the decomposition of hydrogen peroxide by potassium ferrocyanide or sodium nitroprusside, a pronounced after-effect of illumination has been observed by many workers.[1,2,3] From a study of the decomposition of hydrogen peroxide by potassium ferricyanide, however, Rao and Srikantan[4] have come to the conclusion that no after-effect of illumination is detectable in the reaction. On the other hand, the illuminated ferricyanide has been found by them to produce a distinctly lower rate of decomposition than the uninsolated solution. In view of the closely related nature of ferrocyanide, nitroprusside and ferricyanide the complete absence of the photochemical after-effect in the latter appeared to us rather surprising. It was, therefore, thought desirable to investigate the decomposition of hydrogen peroxide by potassium ferricyanide in detail.

We have been able to observe a remarkably large photochemical after-effect in the decomposition of hydrogen peroxide by pre-insolated ferricyanide, particularly when some unilluminated ferrocyanide is also present in the reaction mixtures. The irradiated ferricyanide solution shows a much enhanced reactivity towards hydrogen peroxide in the dark. Furthermore, this enhanced reactivity which manifests itself as the photochemical after-effect is retained for a long time, although after irradiation it continues to diminish gradually on standing in the dark.

The dark reaction between N/10 H_2O_2 and M/300 $K_3Fe(CN)_6$ at 25 ± 1° C. is exceedingly slow and shows an autocatalytic course with the progress of the decomposition. We have been wholly unable to observe a constant unimolecular rate of decomposition at any stage of the reaction. The ferricyanide solution, insolated for 20 minutes, produced a considerably higher rate of decomposition of the peroxide, but the course of this decomposition was likewise autocatalytic as that of the dark reaction. This after-effect is markedly increased by the addition of a suitable amount of uninsolated ferrocyanide to the reaction mixture, and what is more important, the unimolecular velocity constants maintain a fairly uniform, though much higher value throughout the course of the decomposition.

Dark reaction between H_2O_2 and $K_3Fe(CN)_6$

t	$a-x$	$K.10^8$
0	22·20	—
2885	21·90	203
3348	21·80	236
4300	21·65	253
6010	21·40	256
7817	20·90	336
8815	20·30	495
12792	18·80	564

Dark reaction between H_2O_2, $K_3Fe(CN)_6$ and M/300 $K_4Fe(CN)_6$*

t	$a-x$	$K.10^6$
0	20·40	—
81	19·70	186
235	18·80	149
448	16·30	217
775	12·50	274

* With $K_4Fe(CN)_6$ alone, apparently the same order of K is obtained.

Dark reaction between H_2O_2 and pre-insolated ferricyanide and M/300 ferrocyanide

t	$a-x$	$K.10^6$
0	22·40	—
965	21·00	29
1493	19·85	35
Added 0·038 gm. $K_4Fe(CN)_6$		
1631	12·40	--
1687	10·05	1627
1750	8·05	1553
1795	7·00	1515

A study of the irradiated aqueous solution of potassium ferricyanide has led us to the conclusion that an appreciable amount of potassium aquopentacyanoferrate is produced under the influence of radiation.

$$K_3Fe(CN)_6 + H_2O \rightarrow K_2Fe(CN)_5H_2O + KCN. \quad (I)$$

The presence of the aquo complex salt has been proved by a number of qualitative colour reactions. The aquo complex salt causes the measured photochemical after-effect.

The addition of $K_4Fe(CN)_6$ results in the reduction of aquoferrate to aquoferrite.

$$K_2Fe(CN)_5H_2O + K_4Fe(CN)_6 \rightarrow K_3Fe(CN)_5H_2O + K_3Fe(CN)_6. \quad (II)$$

Potassium aquopentacyanoferrite so produced causes a very rapid decomposition of H_2O_2 at a constant unimolecular rate in the presence of a suitable excess of ferrocyanide.

$$2K_3Fe(CN)_5H_2O + H_2O_2 \rightarrow 2K_2Fe(CN)_5H_2O + 2KOH + E. \quad (III)$$

It is suggested that the energy liberated in (III) causes the decomposition of a large number of H_2O_2 molecules. The catalytic system $Fe(CN)_5H_2O \leqslant Fe(CN)_5H_2O_2'$ thus causes a uniform decomposition of H_2O_2 as measured by the after-effect.

Experimental evidence in support of the suggested mechanism of the photochemical after-effect has been adduced by studying the after-reaction in presence of CN′, NO_2′ and C_6H_5NO. The after-effect has been found to be very largely quenched in the presence of these substances. This is to be expected if the photo-formation of potassium aquopentacyanoferrate

from ferricyanide is responsible for the after-effect. The quenching is produced because the highly reactive aquopentacyanoferrite ion is converted into much less reactive substances as follows:—

$$Fe(CN)_5H_2O'''' + CN' \rightarrow Fe(CN)_6'''' + H_2O$$

$$Fe(CN)_5H_1O''' + NO_2' \rightarrow Fe(CN)_5NO_2'''' + H_2O$$

$$Fe(CN)_5H_2O''' + C_6H_5NO \rightarrow Fe(CN)_5C_6H_5NO''' + H_2O.$$

The above conclusions have been experimentally verified and fully substantiated by studying the decomposition by uninsolated ferricyanide and a trace of the photo-catalyst, sodiumaquopentacyanoferrate. We have been able to reproduce the photochemical after-effect in the dark by adding a trace of aquopentacyanoferrate ions to H_2O_2-$K_3Fe(CN)_6$ mixture. A quenching of this effect is also observed in the presence of CN', NO_2' and C_6H_5NO.

The details of the investigation will be published elsewhere.

Chemical Laboratories,
St. John's College,
Agra,
August 9, 1943.

B. B. Lal.
C. P. Singhal.

1. Kistiakowsky, W., *Zeit. Physikal. Chem.*, 1900, **35**, 431. 2. Lal, B. B., *Jour. Ind. Chem. Soc.*, 1939, **16**, **7**. 321. 3. Qureshi, M., *Jour. Physical. Chem.*. 1931, **35**, 656. 4. Lal, B. B., *Proc. Ind. Acad. Sci.*, 1941, **14**, 652, 5. Rao and Srikantan, *Jour. Ind. Chem. Soc.*, 1933, **10**, 29.

A NEW VARIETY OF *ISOACHLYA ANISOSPORA* (deBARY) COKER

In 1888, deBary[1] described a fungus as *Saprolegnia anisospora*. Recently its name has been changed to *Isoachlya anisospora* by Coker and Matthews[2] on sporangial characters. The present material was isolated from a pond, ten miles from Allahabad, using hempseeds as baits. All observations recorded below were made on cultures growing on hempseeds in distilled water.

Isoachlya anisospora (*deBary*) Coker, var. *indica*, nov. var.

Mycelium 8·18-16·36 μ thick. Spores of two kinds, smaller 9 μ in diameter while bigger ones upto 12 μ. Sporangia 14·5-24·5 μ thick and 99-163·63 μ long. Oogonia are spherical; terminal and also rarely intercalary; wall smooth; 37·14-92·85 μ mostly 60-66 μ in diameter; thickness of the wall 1·4 μ.

Antheridia present on all oogonia; long; androgynous and diclinous; applied by sides. Eggs 1-10 in number, never more than ten; 21·81-55·71 μ in diameter, mostly 24·54-35·45 μ; thickness of the wall 3 μ; not completely filling the oogonium; centric or subcentric.

I. anisospora var. *indica* differs from the main species in the structure of the egg which, in the present form, is either centric or subcentric (Figs. 1 and 2). In no case eccentric eggs were formed as described by Coker and Matthews for the main species. Since the egg structure in this form does not agree with that of the

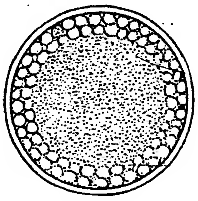


Fig. 1
A centric egg

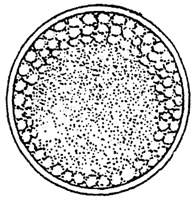


Fig. 2
A subcentric egg

American species, the authors consider it to be a new variety. Prof. W. C. Coker suggests us to call it a form of *I. anisospora*.

We thank Prof. W. C. Coker, University of North Carolina, U.S.A., for his kind advice, and also Prof. S. R. Bose, Carmichael Medical College, Calcutta, and Dr. John Dearness of Canada for communicating our description of the fungus to Prof. Coker.

Botanical Laboratory,
The University,
Allahabad,
February 5, 1944.

R. K. Saksena.
K. S. Bhargava.

1. deBary, A., *Bot. Zeit.*, 1888, **46**, 619. 2. Coker, W. C., and Matthews, V. D., *North American Flora*, 1937, **2**, **17–58**.

PROGRESS OF HOMOZYGOSITY DUE TO BACKCROSSING

According to Mendelian segregation in self-fertilized plants or in selfing cross-fertilized plants involving a single pair of genes, the fraction of the heterozygous individuals gets halved at every successive generation and at the end of a few generations a very large percentage of the population becomes homozygous. Where a large number of genes are concerned, the reduction in the percentage of heterozygous individuals is comparatively slow in the first few generations but later, say after ten generations, this percentage forms only a very small fraction of the population. The formula for determining the percentage of homozygous individuals in any generation following a cross is $\left(I - \frac{1}{2^n}\right)^m$ where n is the number of segregating generations which have elapsed since the cross was made and m, the number of independently inherited pairs of genes involved.

Let us now consider this principle in the case of practical stock breeding, say, improving milk yield in cows. In herds which lack the genes controlling high yield of milk, they may be introduced through mating them to bulls known to possess these genes. The rate of transfer of the genes will be the speediest when the sires selected for mating are homozygous for all the genes involved and the progenies are back-crossed in each succeeding generation to these same individuals or mated

to others having an identical genetic constitution. The rate at which the genes for milk yield are established in a homozygous condition in the population from such matings, can now be calculated and this rate will be a measure of improvement to be expected in the population for the characters under consideration.

With a single gene, say A, carried by the sires all members of the first generation will be heterozygous (A*a*). On mating these heterozygotes again to AA individuals, half of the second generation progeny will be homozygous for A. The other half of the progeny will remain heterozygous and from the mating of this portion of the populations to AA individuals, a further half will be made homozygous in the third generation, assuming, of course, that all matings are equally fertile and yield the same proportion of survivals. Heterozygosity will thus be reduced by a half in each successive generation. The fraction of the population rendered homozygous for the gene A in each successive generation will thus be ½, ¼, ⅛, 1/16 the total proportion of the population expected to become homozygous for the gene in the *n*th generation will, therefore, be the sum of $n-1$ such fractions, since homozygosity is nil in the first generation. The fractions from a geometric series with ½ as the leading form and ½ as the common ratio. The sum is $\left(1-\frac{1}{2^{n-1}}\right)$. If m genes are involved, that is, if the character under consideration is controlled by m genes, the fraction of the population expected to be homozygous for all m genes is obviously $\left(1-\frac{1}{2^{n-1}}\right)$.

By substituting in this formula different values of m, the number of genes assumed, and n, the number of generations, the rate at which the homozygosity increases in the population can be studied. Curves representing the homozygous fraction of the population in different generations are shown in Fig. 1 for the values of m equal to 1, 6 and 100.

If known fractions of the population already possess some of the m genes in a homozygous condition, the progress of homozygosity can still be worked out from the application of the formula separately to each fraction, assuming for the number of genes concerned the value m less the genes already existing in the fraction and taking a weighted sum of the results over the different fractions. For example, if six genes are involved and if 1/10 of the population already possesses one of these genes, the homozygous fraction of the whole population in n generations will be

$$\frac{1}{10}\left\{1-\frac{1}{2^{n-1}}\right\}^{5}+\frac{9}{10}\left\{1-\frac{1}{2^{n-1}}\right\}^{6}$$

The resulting curve practically overlaps the one for six genes (*i.e.*, when the whole population originally lacks in all six genes) and is not shown in the figure.

All curves are asymptotic and complete homozygosity is thus theoretically impossible to achieve in the system considered here; but over 99 per cent. of the population reaches this stage in the eighth, eleventh and fifteenth generations for 1, 6 and 100 genes respectively. In the initial stages also, with a single gene,

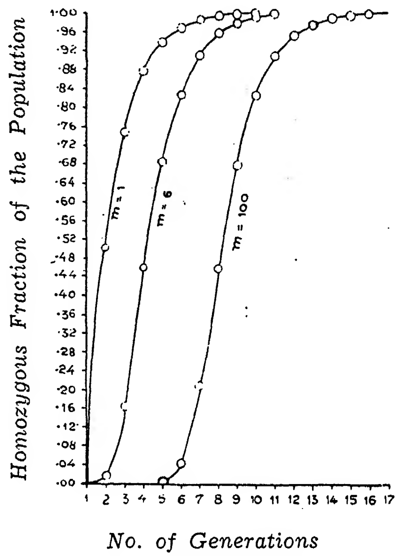


FIG. 1.—Progress of Homozygosity due to Backcrossing (m = No. of genes assumed to control the character)

half of the population becomes homozygous in the second generation, but no sensible homozygosity is found until the sixth generation in a population in which a hundred genes are segregating. The particular generation in which homozygosity is increased by the largest amount may be calculated with the help of the formula given above.

The increase in homozygosity in the nth generation over the preceding generation is

$$\left\{1-\frac{1}{2^{n-1}}\right\}^{m}-\left\{1-\frac{1}{2^{n-2}}\right\}^{m}.$$

Differentiating this expression with respect to n and equating to zero, we have

$$n=\frac{\log\left\{2\,\frac{2x-1}{x-1}\right\}}{\log 2}\ \text{where}\ x=e^{\frac{\log 2}{m-1}}$$

for $m=1$, 6 and 100 the nth generation is second, fourth and eighth. It is thus clear that as the number of genes involved increases, the progress of homozygosity, *i.e.*, the rate at which the genes are established in the population is retarded.

The results given above are derived purely from theoretical considerations and involve simple assumptions. In actual practice, however, the genetic situation is often more complicated as we cannot be sure of the genetic constitution of either the cows or the bulls. If the bulls used do not contain all the genes controlling the character or contain them only in a heterozygous condition the progress of improvement in the herd will be much slower than is shown here. That in cattle improvement the success of any breeding scheme

depends upon the selection of the bulls of the right genetic constitution needs no emphasis.

Cotton Genetics Research Scheme,
Indian Central Cotton Committee,
Institute of Plant Industry,
Indore, C.I., G. R. AYACHIT.
December 13, 1943.

ON THE OCCURRENCE OF *STREPTOCEPHALUS DICHOTOMUS* BAIRD IN TRAVANCORE

ON 8-12-1943, I made a collection of small shrimp-like crustaceans from a fairly big pool of water about half a mile north of the Aquarium building and about two and a half furlongs inland from the Trivandrum beach. These were identified as the fairy-shrimp *Streptocephalus dichotomus* Baird.[1] About hundred specimens were brought to the laboratory and are being reared for further studies. The pool from which the collection was made is a temporary piece of water in a sandy depression which completely dries up during summer. It contained tufts of decaying grass and organic debris, together with some aquatic fauna such as tadpoles, water fleas and insect larvæ. The water at the time of collection had a pH of 7·7 and its oxygen contents was ·46 per 100,000 parts.

These were observed to move about in shoals of 400-500 and normally prefer the deeper parts of the pool. They are transparent and hardly recognisable except for their pigmented eyes and deep orange-red anal lobes. The brood pouch in the female has an orange-red streak on its ventral surface and the second pair of modified antennæ in the male is slightly bluish in tint. The females were fully mature and their brood pouch contained ripe eggs in various stages of extrusion. The specimens measured from 19-22 mm., the males being slightly the longer. Two forms of this species, *viz.*, the typical form as well as a variety *simplex* have been observed to occur together by Gurney,[2] but in the present collection only the typical form with four cirriform appendages at the distal end of the proximal antennal segment has been found to exist.

Only two species of *Streptocephalus, viz.*, *S. dichotomus* Baird and *S. spinifer* Gurney, have been so far recorded from India and Ceylon and of these, the latter species has been found only from Ceylon.[3] The former species has been recorded several times from various other parts of India, both from very high altitudes as well as the plains. The present collection extends further the range of distribution of this species in India.

Marine Biological Laboratory,
University of Travancore,
Trivandrum, K. GOPINATH.
January 3, 1944.

1. Synonymous with *Branchipus (Streptocephalus) bengalensis* of Alcock, *Journ. A.S.B.*, 1896, **65**, 538-39, pl. 10. 2. Gurney, *Ibid* (n.s.), 1907, **2**, 276. 3. Kemp, S., *Rec. Ind., Mus.*, 1911, **6**, 222.

OCCURRENCE OF A NEW VARIETY OF THE SKATE, *UROGYMNUS ASPERRIMUS*, AROUND KRUSADAI ISLAND, GULF OF MANAAR[1]

THE Skate of the genus *Urogymnus* contributes to a fishery of moderate scale around Krusadai and neighbouring islands and the lagoons of Pamban, Gulf of Manaar, from October of one year to February of another year. They are captured by means of stake nets, which are set near the shore especially during New Moon and Full Moon days.

The Skate, on examination, shows the following differences from *Urogymnus asperrimus*,[2] the only species recorded by Day.

Distinguishing characters.—Snout does not project. Scales covering the body are mostly quadrangular in shape. The tubercles on the body are continued posteriorly to the first third of the tail. Where the pectoral fins meet in front of the snout, the outline is not roundish as in *Urogymnus asperrimus*, but is pointed out as in *Trygon sephen*.

Colour.—Body whitish above with black blotches on the head and on the tail, and milk-white below. A U-shaped black line between the eyes. The pectoral fins are greyish with round whitish spots of diameters varying from 3 to 10 mm.

The Director of Zoological Survey, to whom a specimen was sent, is of opinion that the differences noted above do not justify the creation of a new species for the Krusadai form. But, as all specimens recorded in this area show the above differences, the Krusadai form is given the status of a new variety, namely, *Urogymnus asperrimus* var. *krusadiensis*.

Fisheries Bureau,
Triplicane, Madras, P. I. CHACKO.
February 18, 1944.

[1] Published with the permission of the Director of Industries and Commerce, Madras.

[2] Day, F., *The Funa of British India*, *Fishes*, 1889, **1**.

A PRELIMINARY NOTE ON THE BREEDING OF A BENEFICIAL ECTOPHAGOUS LARVAL PARASITE (BRACONIDÆ) ON A LABORATORY HOST

As a result of several attempts made very recently in this Laboratory a measure of success has been finally achieved in the matter of rearing out *Microbracon hebetor*, the larval, natural parasite of the Lab-lab Pod-borer, *Adisura atkinsoni*, on the larva of *Corcyra cephalonica* St., the common caterpillar pest of stored rice, jola and flour. The larvæ of *Corcyra cephalonica* St., the laboratory host, were offered to the parasites under environmental conditions, somewhat simulating those obtaining in a crop of Lab-lab.

One generation of twenty-two parasites, nine males and thirteen females, was reared out from a culture of six host larvæ, to which a batch of five natural parasites (two females and three males) recovered from field-parasitised pod-borers, was introduced: four of the

six host larvæ in this culture were successfully parasitised.

In a second culture, also treated with parasites emerged from field-parasitised pod-borers, one successfully parasitised host-larva, yielded two parasites (one male and one female).

From a third culture exposed to a mixture of a few parasites of the first generation bred from the first culture and others emerged from field-parasitised pod-borers, a third set of eight parasites (one female and seven males) from two successfully parasitised host-larvæ, emerged out. In the second and third cultures, the prevalent micro-climatic conditions were not quite typical of those present in the first.

As far as the writers are aware, this is the first instance, in India, of successful breeding of this beneficial larval parasite on a host, other than its natural host; *i.e.*, on a laboratory host. It may not be out of place, here, to state that the egg of this same laboratory host, *Corcyra cephalonica* St., is already being used for the past ten years, at the Mandya Parasite Laboratory, for the mass-production of the beneficial egg-parasite, *Trichogramma minutum* R., utilised against the destructive stem-borer pest of sugarcane, in the Irwin Canal tract.

This, now, opens up possibilities of mass-rearing, in the laboratory, *Microbracon hebetor*, and probably other beneficial larval parasites for utilisation in the biological control of certain harmful pests, which are at present, being controlled by other methods.

Entomological Laboratory,
Department of Agriculture,
Bangalore, B. Krishnamurti.
March 10, 1944. D. Seshagiri Rao.

ON THE OCCURRENCE OF *CNAPHALOCROCIS MEDINALIS* AS A PEST OF PADDY IN TRIVANDRUM AND THE INDIGENOUS METHOD OF COMBATING THE SAME

Very recently some of the late-sown paddy fields in Trivandrum showed heavy attack by this insect pest which, as a rule, appears only occasionally. In those fields sown at the proper time the injury was slight but in the late-sown fields the seedlings were tender and weak and the depradations of the insect were most obvious. In two or three blocks all the seedlings had become whitened and sickly and from a distance looked as if lime had been splashed over the whole field.

The way the local peasants handled the situation was very ingenious and interesting. They brought twigs of a wild tree—*Holigarna arnotiana* (Anacardiaceæ) and moved them amongst the seedlings and even planted them amidst paddy seedlings. In a fortnight the seedlings began to recover. On examination these fields were found to be crowded with spiders of various types. Towards dusk the spiders were busy spreading their snares in all directions. The innumerable snares formed a sort of canopy on the seedlings, and the moths that emerged at night were very probably destroyed by these spiders. Other spiders (Attidæ) were noted destroying the caterpillars which are directly responsible for the damage to the paddy.

This method of control is a very simple, yet efficient type of biological (Predatorism) control, used by a people most of whom are illiterate. In January 1944, the fields referred to above presented a different spectacle. The insect pest was not at all seen. The crop had mostly recovered. The abundant spider fauna had also reduced to a small number.

Spiders form a large group of exclusively insectivorous animals. They naturally play an important part in the biotic control of insects in any locality. But little attention has been given to their role in the balance of nature and very little effort has been made to estimate or understand the service rendered by this group of animals to human welfare. The abovementioned observation is a very vivid attempt on the part of the illiterate Indian cultivator to make use of these creatures for his purpose.

In the course of certain observations on the destruction of insect pests by spiders around the writer's house in Trivandrum large numbers of spiders were found busy spreading their snares which were observed, to contain, in addition to sucked up bodies of the major victims innumerable gnats and mosquitoes entangled in the viscid threads. These gnats and mosquitoes on the spider webs near the doors and windows of the house, indicated that they were probably attracted by the light in rooms and that they would have got in, but for the interception of the silky webs.

A large spider (Herennia) which had made its snare on the bark of a tree, destroyed certain hairy caterpillars which attempted to climb that tree.

The common house spider (Heteropoda) is well known as a destroyer of cockroaches and such other undesirable insects intruding into the household.

In the local wooden granaries several forms of spiders building their webs inside are probably responsible for destroying many adult moths (*Sitotroga cerealella*) a common pest of stored paddy, and keeping down the incidence of the pest.

The foregoing instances would clearly demonstrate that these much neglected animals form a very important cog in the wheel of life, serving as natural check on the undue increase of insect pests, especially in the tropics and deserve much more attention and recognition than has been usually bestowed on them.

Zoology Department,
University College,
Trivandrum, A. P. Mathew.
January 15, 1944.

A HOME FOR THE LEPERS

"Poor without kin or friend or ties of blood am I
Save me, before it be too late from this, my curse."

The "curse" has assumed a dreadful shape. We have to-day a half of world's lepers amidst us. Fighting this malady out is pretty difficult. But fight we must somehow. Success depends on co-ordinating the work hitherto done and the Central Government taking the initiative. The problem may be examined under four heads, namely, Investigation, Segregation, Treatment and Control.

Investigation consists in ascertaining the exact numbers suffering as also the enlistment of new cases, the best instruments for that being the Public Health Department and the medical profession in general. But investigation can be successful only with the patients' co-operation ensured through propaganda and promise of attractive life within the Leprosaria. One method is a systematic examination of school children, college students, employees of Government Departments and commercial houses.

Segregation is the organisation of Leper Colonies, climatic suitability and sanitation being of primary importance in selecting sites. Each must accommodate: (1) those to whom the disease is a newly begotten wealth, those suffering for a long time and those in whom the disease is extinct, (2) intimate relations, dependants, children born in the Leprosarium and the healthy children of the patients.

Education, social amenities and economic self-sufficiency are important. Agriculture and small industries may be made the chief occupations for the milder cases. A Leprosy Expert, assisted by an Administrative Officer and a host of medical men, will be the Colony-Chief. A Research Laboratory attached to the Leprosarium will have three qualified scientists who will be in constant touch with the Federal Leprosy Institute, working independently on different aspects of the disease.

We are still Atreyan in the matter of treatment makes necessary the establishment of a Federal Council of Research to devote its complete attention to Leprosy research. The governing body must consist of a Member of the Viceroy's Executive Council, Director-General of Medical Services, Director of the Indian Institute of Science, Director of Industrial Research and the Director of the Federal Leprosy Institute attached to the Council, with the Assistant Director as its Secretary. The Council shall conduct a Journal, namely, *The Transactions of the Federal Institute of Leprosy* as also a special course in Leprosy.

Control can be made easy and effective by restricting the number of Leprosaria to one for each Province and making the Director of Public Health its administrative head, administration of justice being entrusted to the nearest magistrate. A new "Indian Leprosy Act" will set the scheme in motion.

Madras, M. PADMANABHAN.
March 6, 1944.

---

* I am thankful to Dr. M. K. Subramaniam for the interest created in the subject.

THE CRITICAL DISCHARGE OF STREAMS IN UNIFORM FLOW

IN two recent communications,[8,9] the writer has shown how to deal with the problem of the critical shear stress. There are in use, two more methods of correlating the particle characteristics with the hydraulic elements of streams, when the sediment particles, initially lying quiescently on their beds, are ejected and propelled forward. These are respectively known as *the critical discharge* and *the critical mean velocity* relations.

At present, there is no satisfactory solution of these, any existing formulæ being true for certain special particle sizes and with little physical significance.

However, the writer has made certain satisfactory calculations of these, and their full account will be published elsewhere. In this note and a subsequent one, I summarise these, the present note being devoted to the question of the critical discharge and the relevant calculations.

There are various ways of arriving at the same result. One of these is to obtain it from the solution of the critical shear stress, there being two lines of attack. Both of these are quite general, but the procedure we adopt here appears to be more significant. It establishes in an instructive and convincing manner, the close interrelationship between the various critical relations. And so, the claim of superiority for one over the others, made by some of the investigators,[7,10] appears to be invalidated.

The law of the critical shear stress velocity for particles with the same fineness ratio reads

$$U\tau_c/V_s = f(\rho_w U\tau_c k/\mu) = F(\rho_w V_s k/\mu), \qquad (1)$$

where

$U\tau_c = \sqrt{\tau_c/\rho_w} =$ critical shear stress velocity at the bed $[L\,T^{-1}]$, τ_c $[M\,L^{-1}\,T^{-2}]$ being the critical shear stress at the stream bed,
$\mu =$ fluid viscosity $[M\,L^{-1}\,T^{-1}]$,
$\rho_w =$ fluid density $[M\,L^{-3}]$,
$V_s =$ terminal velocity of the sediment particles $[L\,T^{-1}]$, and
$k =$ particle diameter $[L]$.

In this, we first split up $U\tau_c$ and write it as $(U\tau_c^2 \cdot U\tau_c^2 \cdot U\tau_c)^{1/5}$. Then making use of the equality

$$U\tau_c^2 = g\, D_c\, i_c, \qquad (2)$$

where

$g =$ acceleration due to gravity $[L\,T^{-2}]$,
$D_c =$ critical channel depth $[L]$, and
$i_c =$ critical channel slope $[-]$,

we get for $U\tau_c$, the equivalent expression

$$(D_c\, i_c)^{1/5}\, (g^2\, D_c\, i_c)^{1/5}\, U\tau_c^{1/5}. \qquad (3)$$

We next multiply this quantity by $\left(5\cdot75 \log_{10} \frac{0.4\ D_c}{y_0}\right)^{1/5}$ and divide it by $(D_c\ i_c)^{1/5}$, where y_0 $[L]$ is a small distance inwards from the bed, where the velocity is taken as zero. Both of these are non-dimensional, $(D_c\ i_c)$ being divided by a unit width. Hence, as the critical mean velocity relation reads

$$\bar{U}_{mc} = 5\cdot75\, U\tau_c \log_{10} \frac{0\cdot4\ D_c}{y_0}, \qquad (4)$$

we get

$$U_{Qc}/V_s = f_1(\rho_w U\tau_c k/\mu) = F_1(\rho_w V_s k/\mu)$$
$$= F_1(\rho_w \bar{U}_{Qc} k/\mu), \qquad (5)$$

where $\bar{U}_{Qc}$ $[L\,T^{-1}]$ is short for $g^{2/5}\, Q_c^{1/5}\, i_c^{1/5}$, Q_c being the critical discharge intensity. This *new variable* has the dimensions of a velocity and so we call it *the critical discharge velocity*.

In sharp contrast to the existing relations, each of these has been verified against very extensive experimental data obtained from independent sources. Table I, recording the approximate lower and upper limits of the various variables (ordinarily varied), gives an idea of the range of the data employed, whereas Fig. 1, typical of its kind, demonstrates the high correlation of the data on these bases.

The figure shows how the critical discharge

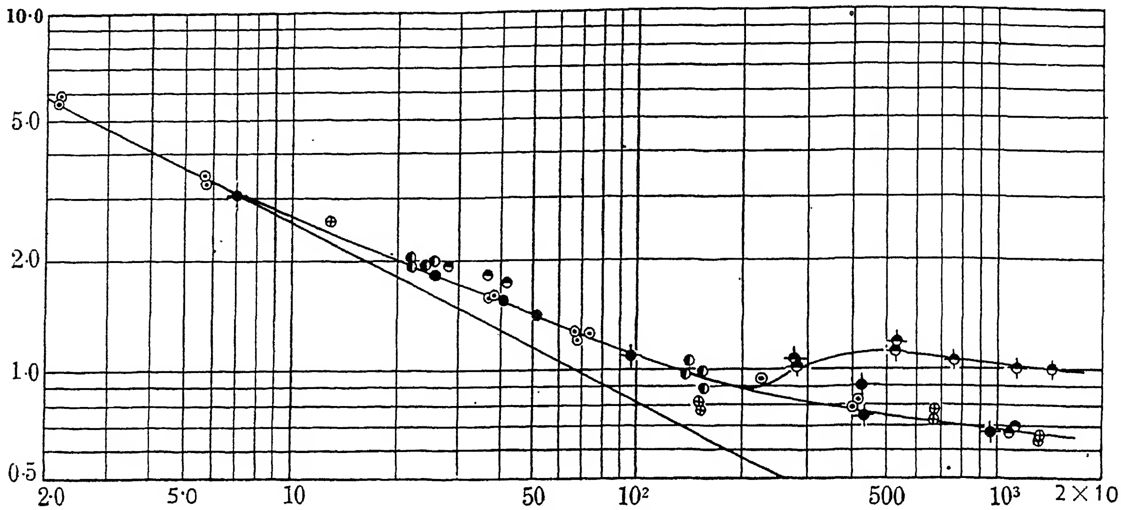


FIG. 1. Analysis of the Critical Discharge Data.
$\bar{U}Q_c/V_s$ Plotted against $\rho_w V_s k/\mu$

Observations with uniform grains: ⊙ Casey[2]; ⊕ Gilbert[3]; Srichamara[11].

Observations with mixtures: ◐ Casey[2]; Ho[4]; ● Kramer[5]; U. S. Waterways Experiment Station.[12]

velocity (so also the critical discharge intensity) varies with the Reynolds Number. In particular, it establishes that the critical discharge will vary if changes are made in the viscosity of the fluid. This is confirmed by an experimental investigation conducted by Ho[4].

TABLE I

Showing Lower and Upper Limits of the Various Variables in (5)

Variable	Lower Limit	Upper Limit
$U_{\tau c}$ (cm./sec.)	1·54	7·68
$\bar{U}Q_c$ (cm./sec.)	8·67	22·44
V_s (cm./sec.)	1·50	23·50
k (mm.)	0·175	6·99
$\rho_w U_{\tau c} k/\mu$ (–)	2·12	467·00
$\rho_w \bar{U}Q_c k/\mu$ (–)	12·53	1370·00
$\rho_w V_s k/\mu$ (–)	2·16	1430·00

While observations show the various non-dimensional groupings in (5) to be true,* practice reveals them to be somewhat inconvenient, specially when the particle sizes corresponding to given values of the critical discharge velocities are to be determined. But it is quite easy to deduce expressions, obviating this inconvenience. All we need do is to extend to (5), the reasoning applied to the case of the calculations of the critical shear stresses and the sediment sizes.[9] By doing this, we get the result

$$\frac{\bar{U}Q_c^2}{\left(\frac{\rho_s}{\rho_w}-1\right)gk} = F_2\left[\left(\frac{\rho_w}{\mu}\right)\frac{\bar{U}Q_c^3}{\left(\frac{\rho_s}{\rho_w}-1\right)g}\right] = F_3\left[\left(\frac{\rho_w}{\mu}\right)^2\left(\frac{\rho_s}{\rho_w}-1\right)gk^3\right], \qquad (6)$$

in which the dependent variable is expressed in terms of parameters which are made up of ρ_s, ρ_w, μ, g and either $\bar{U}_{Qc}$ or k. Here $\rho_s [M L^{-3}]$ is the sediment density.

These functions check well against a large amount of observational material. The curves plotted according to them possess very significant properties and give rise to certain interesting relations. We, however, detail these elsewhere. Here we shall make only one general observation, which concerns the slope-discharge relations suggested for use in the design of stable channels.[1,6,13] *This is that in the light of our analysis, which is seen to be fairly comprehensive, such relations are not true of form and lack any general validity.*

Jamnadas Dewanmal Road,
Ratan Talao,
Karachi, MOHD. SALEH QURAISHY.
November 25, 1943.

* I hope to revert to the problem at some future date, when I shall deal with certain anomalies and their solution.

1. Bose, N. K., and Malhotra, J. K., *Res. Publ. Punj. Irrig. Res. Inst.*, 1939, **2**, No. 23. 2. Casey, H. J., *Dissert. Dok. Ing. Tech. Hoch. Berlin*, 1935. 3. Gilbert, G. K., *Prof. Pap. U. S. Geol. Survey*, 1914, No. 86. 4. Ho, P. Y., *Dissert. Dok. Ing. Tech. Hoch. Hannover*, 1939. 5. Kramer, H., *Ibid., Dresden*, 1932. 6. Lacey, G., *Centr. Bd. Irrig. Publ.*, 1939, No. 20. 7. Meyer-Peter, E., Favre, H., and Einstein, H. A, *Schweiz. Bauztg.*, 1934, **103**, 147–50. 8. Quraishy, M. S., *J. Univ. Bomb. Phys. Sci. No.*, 1943, **13**, Pt. 3, 37–46. 9.—, *Curr. Sci.*, 1943, **12**, 233–34. 10. Schoklitsch, A., *Wasserkr. u. wirtschaft*, 1934, **29**, 37–43. 11. Srichamara. P., *Ph. D. Thesis, Univ. London*, 1938. 12. U. S. Waterways Expt. Stn., *Pap.*, 1935, No. 17. 13. White, C. M., *Rep. Assoc. Inter. Hydrol. Sci., Cssion. Potom.*, 1939, Q. **3**, No. 1, Washington.

REVIEWS

Annual Review of Physiology, Vol. V.—By James Murray Luck and Victor E. Hall. (American Physiological Society and Annual Reviews, Inc., Stanford University, P.O. California), 1943. Pp. viii+613. Price $5.00.

Twenty-two themes are covered by the Annual Review for the year 1943; most of them are devoted to a discussion of the advances made in the field of physiological tissues and tissue-fluids, like the bone, the muscle, the liver, the nerve, the blood, the bile and the mammalian semen. The review includes a critical review of the physiological and pathological effects of ultra-violet radiation, in which reference has been made to the relatively high incidence and nature of mutations induced by ultraviolet radiation as compared with the changes brought about by X-rays. In discussing the relation of ultra-violet radiation to cutaneous cancer, the author significantly remarks, "The possibility that the carcinogenic action of ultra-violet radiation resides in its ability to induce mutations in somatic cells has been suggested. There are many interesting parallels between the two phenomena, and the hypothesis must be seriously considered although the existing evidence may be interpreted in other ways."

The useful review of the physical properties of protoplasm will interest the growing number of cytologists who are interested in elucidating the nature of this fundamental living matter. Geneticists will feel particularly interested in the highly stimulating and able review on the physiological aspects of genetics. The author has drawn attention to the fact that nucleoproteins constitute the common basis on which the two self-reproducing entities—the virus and the gene—are built up. Those interested in the microbiological assay of vitamins will find much useful information on the possibility of evolving new mutants capable of responding to specific vitamin deficiencies.

In the course of the active prosecution of the war, the human organism is being subjected to abnormal conditions of existence, both at the home and the battle fronts. Men and women working in the munition factories at high pressure, pilots flying at and dive-bombing from high altitudes, navigators at and under the sea, men in the land fighting, are obliged to subject themselves to stresses and strains to which their body is not ordinarily accustomed. The extent of the strain which the various parts of the organism can bear without impairing its normal function, has lately formed the subject of intensive physiological investigations now under way. Although much of this work will necessarily remain a close secret for the duration of the war, glimpses into such types of study are, however, discernible in some of the reviews contained in the volume. Reviewing the physiology of the respiratory system, Lt.-Commander Gemill writes, "A tremendous interest is being taken in the latter (anoxia) in view of its practical nature in aviation. However, it must be kept in mind that only when an aviator goes above 35,000 feet while breathing pure oxygen does he become anoxic. Even at 40,000 feet, his anoxic symptoms are very slight. Therefore, anoxia is a very small problem in aviation as long as the aviator is supplied with adequate oxygen. The results of many investigators in the field of anoxia and in the methods of supplying oxygen to the aviator cannot be published until the war is over. It may be said, however, that many advances in physiology of respiration will be made during these crucial war years."

These reviews are indispensable not only to advanced investigators in the field of physiology but also to the progressive medical man who wishes to keep himself abreast of the developments in physiology.

Carnegie Institution of Washington Year-Book No. 41, 1941-42, Washington, D.C., 1942.

The research activities of this great Foundation for the year ending 31st October 1942 form the subject of an interesting report by the President of the Institution. The entire facilities and the resources of the Institute were mobilised for the promotion of war effort. The President adds, "After Pearl Harbour this country ceased to be an oasis in a world at war, and entered upon a period of strife and sacrifice. To the Institution there is an intensified opportunity to serve the nation in its peril, and the effort indeed calls for the sacrifice of precious things. To only a minor extent can we still hope to continue progress in paths of research toward distant cultural objectives, and by keeping the road open avoid the loss of ground already gained. Not all scientific talents are of such nature as to be immediately and directly applicable to the waging of war, and hence the transition has occurred more rapidly in some departments than in others. The utmost effort of our research, however, wherever it has been possible to divert it successfully, is directed toward placing more powerful weapons in the hands of the youth of the land and toward devising means better to protect their health in combat, by guarding against the rigours of disease and unnatural stress. To the extent of our ability and resources and to the full effort of our personnel as it becomes determined how they can best serve, the Institution is committed to the service of the nation at war."

Arrangements have been made for the installation of a cyclotron at the Department of Terrestrial Magnetism. A comparative study of the genetic effects induced by X-rays, ultraviolet radiations and neutrons is being made in the department of genetics. The fibre-yielding hemp and the rubber-bearing Russian dandelion have been both subjected to polyploidy investigations.

Sandstone Water-Supplies of the Joliet Area, Bulletin No. 34 of the State Water Survey Division, Illinois, 1941. Pp. 128.

A progressively increasing demand for water and a steady recession of the water-level in the wells of the Joliet-Washington-Morris area prompted the preparation of this report which deals with 49 municipal and industrial supplies derived from over 100 wells. The report includes a map of the area, complete logs of the wells and the results of chemical examinations of the waters.

Water is obtained from three sandstones which are separated from each other by impermeable beds—(1) *the St. Peter* sandstone, occurring at a depth of about 650-700 ft. and extending to a thickness of 150-200 ft.; (2) *the Galesville* sandstones (100-200 ft. thick), occurring at a depth of about 1,300 ft.; and (3) *the Mount Simon* sandstone, occurring at depths of 1,500 ft. or more. The limestones and dolomites overlying the St. Peter sandstones also yield water to a varying degree depending on the extent to which they are cracked and creviced.

Not only is the hydrostatic pressure of each formation different but this pressure also varies from one locality to another. When wells are drilled to open up every water-bearing formation, the resultant hydrostatic pressure is a balancing of the individual pressures.

During the period of 25 to 30 years the wells have shown considerable recession in water-levels amounting to as much as an average of 62 ft. per year in one case. The absorption-area of these aquifers is in the South and Central Wisconsin and it is stated that the rate of movement of groundwater is as low as 100 ft. per year so that the rate of recharge of storage would be too slow to be of value in Illinois irrespective of the precipitation in the absorption area.

Water from any one formation at a particular location is of distinct composition. But the quality of water obtained in a borewell depends on the effectiveness of sealing off the other water-bearing strata.

Waters occurring in the limestone, shale and dolmite are very variable in composition. They are usually very hard and contain large amounts of sulphates but, occasionally, zones of soft water are encountered.

In some places, the limestones are able to yield as much as 100-150 gallons per minute (g.p.m.) so that there is considerable chance of this water contaminating the water from the upper sandstones. The St. Peter sandstones yield about 75-100 g.p.m., the Galesville, about 600 g.p.m. The Mt. Simon sandstones are very prolific yielders but the water has a very high salt-content. Wells drilled in this formation are, therefore, capable of influencing the mineral quality of wells in the immediate vicinity because the high hydrostatic pressure forces salt-water into the upper aquifers of lesser hydrostatic pressure. It has frequently been found necessary to plug back wells drilled to reach this formation.

The authors have taken great pains to collect complete and authentic data regarding the strata, the yield and chemical features of the water. The book is attractively got up and would prove useful to students of hydrology.

K. V.

SCIENCE NOTES AND NEWS

Patulin—A Remedy for Common Cold.—Dr. N. K. Basu, Pharmacologist, Scientific and Industrial Research, Delhi, writes:—

Current Science in February 1944 has published a short note on the subject. As it might create a wrong impression in the mind of the lay public regarding the wonderful activity of the substance, the following note appearing in the *Industrial Chemist and Chemical Manufacturer*, December 1943, might be placed before them.

"Considerable publicity has been given of recent weeks to this substance Patulin, which the *British Medical Journal* refers to as the antibacterial derivative of *Penicillin patulum* Bairiar, and the controversy has already started. A sample of the preparation had been sent to the laboratories of the Imperial Cancer Research Fund for therapeutic tests in cancer, and W. E. Gye, suffering at the time from a severe cold, tried a solution of it as a nasal dcuche. Since then a large-scale clinical trial has been carried out at a naval establishment with satisfactory results. But clinical trials at a primary training wing by officers of the R.A.M.C. led them to conclude that Patulin had no demonstrable effect on the course of the series of colds that were treated. Here we have one of those perfect instances where experts disagree." The *British Medical Journal* sums the situation very neatly by suggesting that serious attempts should be set on foot to elucidate the processes involved in the use of a mould preparation to obtain inhibitory action on the growth of viruses; and there possibly the matter can rest until some more work has been carried out.

Dr. Ralph W. Philips, Expert on Animal Genetics in the United States, Department of Agriculture, has been invited by the Government of India to study the position of cattle breeding in this country and suggest a long-range programme for adoption during the post-war period. He is touring India with a view to obtain first-hand knowledge of the problem.

Six young Holstein bulls which were purchased by the British army from a large dairy farm near Chicago, will be shipped to India to breed the sacred "Brahma" cattle. In this

connection the *New York Herald Tribune* observes editorially that this shipment of bulls is in a sense repayment of the old debt which the American cattle industry owes to India.

"Forty years ago when James Wilson was the Secretary to the Agricultural Section, a small shipment of 'Brahma' bulls was brought to South Texas to be crossed with beaf cattle there. Wilson believed, along with farsighted cattlemen, that the progeny would be able to withstand the terrific heat in South Texas and be more resistant to disease. The experiments turned out well. To-day there are tens of thousands of descendants of these 'Brahma' bulls."

The Advisory Board of the Imperial Council of Agricultural Research, at its annual session held recently in Delhi, decided to appoint a Sub-Committee to put up proposals for post-war reconstruction in the spheres in which the Council is interested. The memorandum prepared by this Sub-Committee will be considered by a special meeting of the Advisory Board of the I.C.A.R. before being submitted to Government.

Addressing the joint session of the Council of State and the Legislative Council, held on Thursday, the 17th February 1944, H. E. the Viceroy declared: "The post-war world will be, for India, a world of great opportunities and great dangers, in which she has an outstanding role to play. It is our present business to prepare her, materially and morally for these testing years.

"Let us count the blessing first, India has great undeveloped resources, in agriculture and industry. Her soil is not yet cultivated to its full fruitfulness; with an improvement in methods in irrigation and in fertilization, we can increase our food supply greatly, both in quality and quantity. We can much improve the breed of cattle. There is wide scope for development in India's main industry—agriculture.

"There are also great commercial possibilities in India. There are mineral resources still undeveloped; there is abundant labour, a portion of which has now attained a considerable degree of technical skill. India has many experienced and able men of business. Her financial position at the end of this war should be a good one. There are almost unlimited markets, internal and external, for her produce.

"Such are her main common assets. She has, however, also many economic difficulties and disabilities. The pressure of increasing population; the small percentage of educated persons, the low standard of health services, the poor conditions in which the greater part both of the agricultural and labouring populations live, the flagrant contrast between wealthy and poor, the inadequacy of communications, all mark the immensity of the problem which confronts India in raising the standard of living.

"Our task is to use rightly, and to best advantage her great economic assets not to increase the wealth of the few but to raise the many from poverty to a decent standard of comfort. A hard task indeed, but a noble task, which calls from all a spirit of co-operation, a spirit of hope and a spirit of sacrifice.

"The present Government means to prepare the way for India's post-war development with all earnestness of spirit and with all resources, official and non-official, which it can enlist."

It is officially announced that the Egyptian Government are allocating £1,500,000 from the general reserve to combat malaria in Southern Egypt. The credit will be met by supplementary taxes on landowners in the malaria-affected provinces.

Khan Bahadur Afzal Hussein, Vice-Chancellor of the Punjab University, and Mr. C. H. Parr, Imperial Agriculturist, have been deputed by the Government of India to attend the Agricultural Development Conference at Cairo. Mr. Parr has suggested to the Conference the formation of an international league to deal with problems of soil erosion which is becoming menacingly serious. Khan Bahadur Afzal Hussein advocated the institution of a chain of agricultural research stations as an integral part of every university.

The Chronica Botanica Co., of Waltham, Mass., has issued a special edition of Dr. C. A. Browne's "Thomas Jefferson and the Scientific Trends of his Time" (an advance reprint from *Chronica Botanica,* Vol. 8) on the occasion of the tenth anniversary of its establishment. The Chronica Botanica Co. was founded in Leiden, the Netherlands, in September 1933 and was transferred to the U.S.A. early in 1940. An old interesting, symbolic engraving, reproduced on an insert with the commemorative booklet, recalls the successful transfer of the firm's entire stock and their unique collection of source material in the history of botany and horticulture, just a few months before the invasion of the Low Countries. The firm, which is directed by Dr. Frans Verdoorn, publishes *Chronica Botanica, A New Series of Plant Science Books,* and *Annales Cryptogamici et Phytopathologici* (formerly *Annales Bryologici*). Special projects in the course of preparation include: "Plants and Plant Science in Latin America" and the "Index Botanicorum".

In reply to a question in the Central Assembly, Sir A. Ramaswami Mudaliar revealed that agricultural machinery valued at 1,107,000 dollars had been received from America under Lend-Lease up to the end of October 1943. This machinery included tractors, scrapers, ploughs, rooters, milk cans, hay-balers, pasteurisers, harrows and cultivators. Agricultural machinery worth 1,042,000 dollars had been distributed to military centres, Government dairy farms and the balance, worth 65,000 dollars, would be distributed to essential users through stockist agents.

Sir C. V. Raman, KT., F.R.S., N.L., has been invited to address the Royal Society of Arts on "The Progress of Science in India".

The Persian Cultural Mission, led by Professor Ali Asghar Hikmat, is visiting important

centres of learning and research in this country. Referring to the Mission's visit to the Imperial Agricultural Institute, New Delhi, Professor Hikmat declared that it was one of the institutions of which they wanted Iran to take the fullest advantage. He hoped to send agricultural graduates from Teheran to the Institute for advanced studies.

India is expected to reach a state of self-sufficiency in 1945 with respect to her needs of vegetable seeds. A scheme for the production of acclimatised European vegetable seeds has been taken up in Kashmir and Beluchistan with financial assistance from the Imperial Council of Agricultural Research.

MAGNETIC NOTES

Magnetic conditions during February 1944 were less disturbed than in the previous month. There were 19 *quiet* days, 9 days of *slight* disturbance and 1 day of *moderate* disturbance as against 5 quiet days, 22 days of slight disturbance and 1 day of moderate disturbance during the same month last year.

The quietest day during February 1944 was the 27th and the day of the largest disturbance the 7th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Moderate
1–6, 12, 16, 17, 19, 21–29.	8–11, 13–15, 18, 20.	7

No magnetic storm occurred during the month of February 1944 while one moderate storm was recorded in February last year.

The mean character figure for the month of February 1944 was 0·38 as against 0·86 for February 1943.

A. S. CHAUBAL.

We acknowledge with thanks the receipt of the following:—

"Nature," Vol. 152, Nos. 3860-65, 3867-68.

"American Museum of Natural History," Vol. 52, No. 3.

"Journal of the Bombay Natural History Society," Vol. 54, No. 2.

"Journal of Nutrition," Vol. 26, No. 3.

"Indian Journal of Physics," Vol. 17, No. 4.

"Journal of Research of the National Bureau of Standards," Vol. 28, Nos. 3 to 6; Vol. 29, Nos. 1, 3-4; Vol. 31, Nos. 1 to 3.

"Science," Vol. 95, No. 2477; Vol. 96, Nos. 2470-81, 2483, 2486, 2498, 2502; Vol. 98, Nos. 2542-2545.

"Scripta Mathematica," Vol. 9, No. 2.

"Science and Culture," Vol. 9, Nos. 7-8.

"Monthly Science News," No. 28.

"Sky and Telescope," Vol. 2, No. 12; and Vol. 3, No. 1.

"Indian Trade Journal," Vol. 152, Nos. 1960-64.

BOOKS

Experiment and Theory in Physics. By Max Born. (Cambridge University Press), 1943. Pp. 44. Price 2*sh.*

Clouds and Whether Phenomena. By C. J. P. Cave. (Cambridge University Press), 1943. Pp. 22. Price 5*sh.*

Are Wars Inevitable? By John R. Swanton, 1943. Pp. 36.

A Text-Book of Sound for B.Sc. Students. (Indian Press, Allahabad), 1943. Pp. 313. Price Rs. 7-8-0.

Control of the Indian Electricity Supply. By K. V. Karantha, 1944. Pp. 58. Price Annas 12.

Geology for Every Man. By Sir Albert Seward. (Cambridge University Press), 1943. Pp. 312. Price 10/6.

District Industrialisation Drive. By Sir M. Visvesvaraya. (All-India Manufacturers' Organisation), 1943. Pp. 44. Price Re. 1.

Industries in Bombay City Monograph 3. (All-India Manufacturers' Organisation), 1943. Pp. 16. Annas 12.

The Rayon Industry, Possibilities of Its Establishment in India. (All-India Manufacturers' Organisation), 1943. Pp. 25. Price Annas 12.

"Annual Review of Biochemical and Allied Research in India, Vol. 13 for 1942. (Society of Biological Chemists, India, Bangalore), 1943. Pp. 101. Price Rs. 3 or 6*sh.*

ERRATA

"Patulin," Vol. 13, No. 2, p. 34, line 2, *for* "*Penicillium notatum*, Bainier" *read* "*Penicillium patulum*, Bainier".

"Origin of Curves in Rivers," Vol. 13, No. 2, p. 38, *for* Fig. 2A with water please refer to p. 278 of Vol. 12, October 1943.

267-44—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Publis!. Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

CURRENT SCIENCE

Vol. XIII] APRIL 1944 [No. 4

THE FUTURE DEVELOPMENT OF THE FIELD VETERINARY SERVICES IN INDIA

At the last meeting of the Animal Husbandry Wing of the Board of Agriculture it was hinted that the Indian Veterinary Services were failing to reach their goal, and it would be a confession of weakness to receive such suggestions either with careless unconcern or helpless dismay. For, if indeed the Veterinary Services have reached a state of stalemate, then the time is long overdue for a thorough ventilation of the whole position. Furthermore, during the same meeting earnest requests were made for concrete proposals for increasing the efficiency of all branches of the service and the present article is intended as a contribution to both these ends.

Considered in their broadest sense the Veterinary Services of India are a chain of communications starting with the collection of knowledge by the investigator, continuing with the impartation of this knowledge to the student or practitioner and ending with the taking of the knowledge to the field. Now, although this chain as a whole may be faltering, it cannot be denied that certain of its links are not only strong but are even rapidly becoming more formidable. Veterinary education, for example, despite minor disagreements as to standards and method is improving from year to year. Whilst, as for research, scheme after scheme is launched and completed and more and more knowledge is daily recorded. Clearly, therefore, these sections of the chain are not at fault and, in seeking a delicate link elsewhere, one is sooner or later struck by the appalling disabilities confronting the veterinarian as he tries to practise his profession in the baffling field conditions of India.

From the veterinary standpoint the difficulties of the Indian moffusil are twofold, *viz.*, difficulties of communications and difficulties concerned with technical methods in semi-tropical rural areas. At present, progress in overcoming these obstacles appears to be awaiting the stimulus of modern practice. Can it be said, for example, that the most highly educated Veterinary Assistant Surgeon posted in a small township is adequately equipped to deal with an outbreak of an unknown infectious disease twenty-five miles away? Can he, in point of fact, despite his modern education, collect a selection of the right apparatus at once, proceed to the outbreak more quickly, make a surer diagnosis and, having applied the right measures, be free sooner for other work than he could a quarter of a century ago? In all probability, no. With a few notable exceptions, he is almost entirely without diagnostic apparatus; he still has to await the railway company's pleasure until he can depart, or chance getting a seat in a bus. Alternatively, he can mount his bicycle, on which little or no delicate apparatus can be carried, and waste untold vital hours wearily plodding to the scene. In any case, he arrives, mentally and physically exhausted and usually has to spend a night away from his hospital, which is, perforce, left in unqualified hands. In this connection, it may be noted that animals are usually available for work in the early morning or at dusk only and, if the Veterinary Assistant Surgeon is dependent on present methods of transport, nights absent from headquarters are almost inevitable. Again, in the routine touring of his jurisdiction, so vital for getting truly in touch with the countryside and winning the confidence of villagers, he, a man trained for brainwork, must waste untold hours a year dulling his wits by pedalling a bicycle or by sitting at railway stations and bus-halts staring into vacancy. Clearly, the facilities for intensive and extensive field practice have not been developed side by side with increasing

competence, and indeed dearly-bought knowledge is being dissipated in the dust of communications.

It appears probable then, that India is not getting a proper return for money spent on veterinary education and research. In the meantime, serum for prophylaxis of cattle disease has already been transported by air in Africa; whilst medical officers are flown to emergency casualties all over Australia.

Modern Methods of Transport

The day of mechanisation has come and sooner or later every efficient field service will have to be motorised. Already, the Army Veterinary Corps is mechanised even for work in roadless Assam, whilst the lesson is clearly to be read from the veterinary practitioner in Europe and America, who simply could not survive competition without his motor car; from the commercial traveller who in olden times visited one town in three days by train, but who now triplicates his business by visiting two towns a day by car; while if further illustration be needed it can be found in every aspect of modern life.

The would-be economist will of course decry the cost, but facts must be faced and either a stagnating service must be endured, in which case the out and out economist would cut the cost of education and research also, or the money must be found. It is a remarkable fact that money can always be found for guns and so why not for butter, which unlike the former, in the long run, pays for itself in a prosperous and healthy community. It might well be added that despite anything that may be said in this article as to the actual modes and methods of advance, the one fundamental obstacle to progress in the past has been the lack of money for elaborating such schemes as are suggested here. The reactionary on the other hand will raise innumerable objections. He will say that India is not suited for motor transport, that the vast majority of villages do not lie on roads, that the Veterinary Assistant Surgeon is not "motor-minded", and so on *ad nauseam*. But history has almost always proved that reactionaries are wrong, and, although it is not suggested that the last word is being offered on the subject, the first half of this paper will be devoted to showing how mechanisation might be applied to the Indian Veterinary Services at the least possible cost and to the greatest possible purpose.

The writer has toured the Indian subcontinent from Cape Comorin to the Hindu Kush and from Bombay to Cuttack, almost wholly by self-driven motor-car, and one or two broad conclusions have been reached. The first is that a motor-car can go almost anywhere that a bullock cart can travel. Or in other words, with the exception of mountainous jungle and deltaic tracts, a suitable motor vehicle can reach most villages quicker than any other form of transport. Again, the motor-car makes the journey irrespective of time-tables; and will carry not only the veterinary officer but all the necessary apparatus and servants from the hospital door to the side of the field casualty. In consequence, it has been found that, whilst the ordinary touring veterinary officer expects, on the average, to visit one village a day for twenty days a month, the motor driver, if he likes, can reach from four to six villages a day every day of the month and in many cases spend his nights in comfort at home. He is, moreover, less tired at his journey's end, so that, whilst his visiting efficiency is increased sixfold, his personal efficiency is unimpaired. It is not surprising, therefore, that the writer has found that success in his own survey work of India has always been proportional to the availability of roads. It may be accepted then, that the efficiency of an officer is increased at least sixfold by the use of a motor-car for all routine touring work. But what of the emergency, the case in which speed will save lives of animals? Take, for example, the control of rinderpest; in most cases an officer equipped with a car can reach an epidemic centre within 100 miles radius in three hours or less whilst the same journey by other transport would take a day. Finally, there comes the question of prestige and advertisement. There is no doubt that smart work and efficiency command admiration and co-operation. A properly equipped motor-car or motor-cycle combination, properly used, would raise the prestige and influence of a veterinary officer enormously, for quick results inspire confidence, whilst delay breeds indifference or despair. In many cases, the over-tired Veterinary Assistant Surgeon arrives late on his bicycle and he can either make a guess at the diagnosis, and if he has it with him, apply the necessary remedy, or he can take samples for laboratory examination the results of which will be a week coming through. But in a week's time all animals that are going to catch the disease are already dead, the owner has forgotten the incident and the second visit of the Veterinary Assistant Surgeon with the remedy only serves to remind the cultivator of an unpleasant experience, in view of which he can hardly be expected to extend a welcome and give his remaining healthy animals for vaccination.

But, if the same work is done by car or motor-cycle, the Veterinary Assistant Surgeon arrives mentally vigorous at the earliest possible time and, having all the necessary apparatus with him, he completes a simple and certain diagnosis, injects the right serum or vaccine at once and is free for other work almost immediately.

It is not suggested, of course, that mechanisation can be applied equally all over the country, for some provinces are fairly well supplied with roads whilst others are almost entirely without. Nevertheless, if something is to be done at all, first things should come first and, because it is impossible to mechanise in say deltaic Bengal, that is no reason why it should not be done in the Punjab. Furthermore, if in a good cattle district well served by roads, it is found that certain quite large percentage of the villages cannot be reached by road, this is no reason at all why those that can be so reached should be denied efficient veterinary services. A start has to be made, even if it is only a small one, and having so

started and given satisfaction to the road-side dwellers, those distant from the roads will ask for satisfaction also and more roads will be made. As has been said before, motor transport has come to stay and, although some still appear to doubt it, it is no longer a luxury but an economic and commercial necessity. More village roads will certainly form part of post-war expansion and it seems quite evident that soon after the cessation of hostilities a modified motorised veterinary service could be introduced in the following Provinces: Punjab, N.-W. Frontier Province, U.P., C.P. and Berar, Orissa, Bihar, Bombay and Madras. Broadly speaking, good cattle- and sheep-breeding areas of these Provinces should receive the first attention.

Organisation of a Mechanised Field Service

Before passing on to some practical considerations of organisation, one or two wider points must be discussed and firstly comes the type of touring that are usual within a province. On the whole it may be said there are two, *viz.*, (1) short daily tours from a local centre within 25-50 miles radius and (2) continuous tours from a provincial or divisional headquarters. The former would be in the hands of the Veterinary Assistant Surgeons or better still a specially trained Mechanised Veterinary Officer and in this case there would be a tendency to divide the cost by giving the District Board some share in the organisation. It would be fatal, however, to permit an unprofessional body to have the slightest control over a technical service which, to achieve uniformity and efficiency, must be undividedly in the hands of the technical head of the provincial department. As for the second type of touring, certain reactionaries might still suggest that this can be better done by train, arguing that it is only on short journies that motor transport has such a marked superiority over rail. Nothing, however, could be farther from the truth, for the writer's experience has proved over and over again that the only journey that can be more efficiently made by train is the very long distance mail-train journey from province to province, and that, on the contrary, any journey up to 250 miles is done infinitely quicker by car. Furthermore, on a widespread provincial or divisional tour a car journey may be broken anywhere, irrespective of time-tables, connections or stations; wayside halts at the side of grazing cattle can be made at will; diversions can be made on the spur of the moment, often without interfering with the dates of the tour programme, but above all, twice the territory can be intimately covered in the same time and with less fatigue. For all these reasons, therefore, a closer contact with the countryside is established.

The shape of things to come is foreshadowed by the vigorous provincial motoring of the original Veterinary Investigation Officers. Their work, however, as their name implies, has been mainly concerned with investigations about which there are few complaints. But the time has now come for developing applied veterinary science on similar lines and some suggestions to this end are offered in the following paragraphs.

Although bearing different names, the veterinary staff of most provinces is much the same and the work of the Deputy Superintendent, or his equivalent sub-divisional or district officer, merits first attention. As far as can be judged, the present duties of most of these officers consist of surprise inspections of the sanitary condition of hospitals, a forwarding agency for orders and regulations and sometimes receptionist work for visitors. Such an officer may have more than one district in his jurisdiction and an operational radius of up to 100 miles. At present, even for the light inspection duties mentioned above, it appears that a Deputy Superintendent can in some cases visit no more than one-fourth of his territory each year. Under the proposed mechanisation, however, each deputy superintendentship would be remodelled on the basis of motor transport, and the incumbent's main duty would be (*a*) the personal supervision of large-scale prophylactic therapy in the field, and (*b*) the organisation and control of various livestock improvement schemes. It must be recalled that in normal conditions he can reach almost any of his hospitals in less than three hours, taking with him all the necessary staff and equipment, and he can leave night or day irrespective of outside influences. His motor vehicle would be permanently fitted up with diagnostic apparatus such as microscope, stains, slides, hand-centrifuge, slide agglutination materials, specimen bottles, etc., and he would be able to stock it within a few minutes with serum, vaccines, and therapeutics for the more usual infectious diseases. It must be emphasised that not even the lowest-qualified veterinarian, let alone the Deputy Superintendent, should be directly concerned with castrating scrub bulls, filing of teeth, treating colic cases or such like stockman's duties, and the latter's work would be to see that he is informed by the former of serious outbreaks of certain scheduled diseases; to get to the outbreak in the manner of a flying squad; to diagnose the condition; to apply the remedy and to return as soon as possible to headquarters. Few outbreaks would require an absence of more than a day, for once prevention has been initiated the Veterinary Assistant Surgeon who would be picked up in passing could complete the work. On the Deputy Superintendent's return journey inspection work and follow-up calls could be made all along his route. During periods when diseases are rare this officer would spend his time scouring his jurisdiction, making friends with the cultivator, initiating propaganda work, organising livestock improvement schemes and giving advice.

The headquarters and jurisdiction of these officers would, if necessary, have to be re-situated, solely with an eye to road communications. Headquarters, therefore, should be placed at cities on important road junctions, whilst, as far as possible, the limits of a jurisdiction would be determined by impassable river crossings or other natural barriers, and in this respect the possibility of temporary road-blocks due to monsoon flooding should not be overlooked.

Officers holding these appointments should be exceptionally energetic and as far as possible

have had special post-graduate training in field diagnosis and preventive therapy. They would have as an assistant a young post-graduate training in field diagnosis and preventive therapy. They would have as an assistant a young post-graduate trainee, ultimately intended as a recruit to the group of Mechanised Veterinary Officers shortly to be described, whilst future Deputy Superintendents would be drawn from men trained in this category.

Now although the ideal would be to motorise all officers below the office of Deputy Superintendent, this is manifestly impossible, at present at any rate. Indeed, in some provinces it might not be impossible to mechanise below this rank. But in others, and specially in important breeding districts, the mechanised Deputy Superintendent might be supplemented by a class of motorised touring veterinary officer or Mechanised Veterinary Officer. One province at least has already separated the touring officers from the hospital officers, which is an excellent arrangement as thereby hospitals are not left for days at a stretch in charge of compounders or stockmen and each class of officer can specialise in his own kind of work. Provinces that are able to proceed with mechanisation in this manner would grade their junior officers into Veterinary Assistant Surgeons in charge of hospitals. These men would be the least trained and except in emergencies would not make visits requiring an absence of more than a few hours from their posts. The other grade would be the touring veterinary officer consisting of selected post-graduate trainees and being as far as possible mechanised (Mechanised Veterinary Officer). A Mechanised Veterinary Officer situated at a headquarters again chosen for its road communications would be given a geographically suitable jurisdiction of say 25 to 50 miles operational radius. His duties would be (*i*) to supplement or join up with the work of the Deputy Superintendent, (*ii*) to diagnose and treat on his own account small epidemics in his own area and (*iii*) to take over from the Veterinary Assistant Surgeon of his territory all the routine touring which had previously necessitated their leaving the hospitals for more than a few hours. His car or motor-cycle combination would be fitted similarly to that of the Deputy Superintendent and as assistant he could carry a stockman who would attend to routine castrations and similar work.

It is not to be expected that even the richest provinces would be completely mechanised all at once, but in the post-war era there is almost certain to be a big disposal of army vehicles, which, as far as cost is concerned, might present an excellent opportunity for acquiring a nucleus of vehicles sufficient for the Deputy Superintendents and specialised work. Thereafter, one or more touring veterinary officers could be mechanised every year, depending on demand and the results of earlier experiences. Whilst on the subject of demobilisation, it must be recalled that many veterinary officers returning from the war would have wide experience of modern mechanised transport. Clearly, these men would have much of the initial training requisite for the work of a mechanised veterinary officer and could probably be diverted to these duties.

Suitable Types of Motor Vehicles

There can be no question but that for the Deputy Superintendent an American-made station-waggon, such as a Chevrolet or Ford, would be most suitable. These vehicles will carry an enormous amount of equipment besides several passengers. In normal times spare parts are available everywhere and every roadside "mistri" understands these reliable models. Nevertheless, whilst they will travel almost anywhere, especially if fitted with extra large sectioned tyres, for Deputy Superintendents situated in special areas a different car might prove more suitable. It is possible, for example, that, where the majority of touring would be in semi-desert tracts, a Willys Jeep would better fill the bill. Whilst, on bridle roads of hilly tracts either a Jeep or a four-speed low-geared 10 H.P. short chassis car, such as the Opel, might be more serviceable.

The Mechanised Veterinary Officer's vehicle would require more careful selection. For the sake of economy, it would be tempting, of course, to provide him with a cheap small horse-powered car such as a Ford 10 or a motor-cycle and sidecar and, where, as in Madras, roads are abundant, this would be sufficient. But in certain cases it might be better for the Deputy Superintendent to be provided with a station-waggon as a general purpose vehicle for his whole jurisdiction, and one of his Mechanised Veterinary Officers given a Jeep for work in a special tract and which the Deputy Superintendent could, if necessary, borrow. Such selections would have to be made on the advice of an officer with wide motoring experience throughout India.

Equipment

Equipment is the next consideration and clearly there are two kinds of field work that require apparatus, one is surgical or clinical and the other is diagnostic. Now it must be clear to every able thinker that the latter is by far the more important of the two, for manifestly, whilst each is indispensable, it is much better to be able to diagnose say an outbreak of anthrax and so save numerous lives than to carry out work of a clinical nature on individual animals.

It has already been seen how a touring officer, being unable to make a field diagnosis, must send samples to the laboratory with consequent delay. It now transpires that in many cases he has actually to write to the laboratory first to obtain the apparatus in which to take and transmit the specimen, thereby doubling his work and extending the period of delay into weeks.

In the past no doubt there has been an excellent excuse for this lamentable state of affairs, for owing to the fact that the duty of diagnosis has been divided among so many, it has been impossible to train and equip everyone sufficiently. The Veterinary Assistant Surgeon, therefore, has remained the jobbing surgeon and the guessing diagnostician. But it is now

apparent that by concentrating diagnostic work in the hands of a few Mechanised Veterinary Officers it is not only possible to increase the scope and speed of the work by means of the car, but it ought to be possible to train and equip the fewer men needed in a manner worthy of the duties they have to perform. As far as post-graduate training is concerned, a step has already been made in this direction, but the key step of mechanisation has so far not been developed, and the question of supply of diagnostic apparatus has not so far as is known been thought of.

The Mechanised Veterinary Officer's diagnostic work can be divided into two classes, *viz.*, direct, *i.e.*, the work he can do himself in his mobile laboratory and indirect, *i.e.*, cases where he has to send specimen for laboratory examination. It is clear, moreover, that in the cause of speedy diagnosis the direct method should be used whenever possible. Indirect diagnosis also includes specimens taken from cases diagnosed directly but which the operator desires to be sent to the laboratory for check. Direct diagnosis could probably be achieved in most of the better known infectious diseases and it might be useful to schedule these conditions and call for special reports on them. Indirect diagnosis would be needed in more obscure conditions which crop up from time to time in certain virus and poultry infections.

For direct diagnosis the first and foremost requisites would be a microscope, slides, and the more ordinary stains. With these and an ability to make satisfactory smears, it ought to be possible to recognise some of the every-day diseases. For the diagnosis of special diseases such as tuberculosis, all that will be required is a special syringe and some tuberculin; for contagious abortion and other diseases recognised by a simple agglutination test a glass plate, some antigen, a few pipettes, and so on. The packing and carriage of such articles is a simple matter and the room occupied in a car is negligible. Further, many provinces may already have sufficient microscopes to equip the few Mechanised Veterinary Officers and the cost of this apparatus would not, therefore, be great. Certain diseases can be recognised by means of a *post-mortem* examination and a suitable *post-mortem* kit would have to be included. A minor surgical kit and castrating instruments could also be carried for the stockman's use.

For indirect diagnosis the euipment would have to be rather more specialised, but it would be little more than elaborately prepared glassware, in the designing of which the advice of an experienced research officer familiar with field technique would be required. Such glassware would have to be properly packed, returned to and re-issued from the parent laboratory whenever samples had to be transported. In passing, it may be mentioned that there is a very wide scope for the use of the thermos flask; an article far from fully appreciated by the field service.

In conclusion, during the transition period, when a policy of jobbing surgery is being altered to one of mechanised state of diagnosis and control of epidemics, it appears that a field *liaison* officer might advantageously be appointed in one or other of the more important research institutions of this country. The duties of this offer, who would require a small staff, would be (1) to advise on mechanisation, (2) to train officers in practical field diagnosis and control, (3) to keep a record of the condition of indirect diagnostic materials coming into the various departments of the institute and, arising from this, to investigate the cause and correct the defects of systems of diagnosis, (4) to develop better methods of field diagnosis, mainly with the object of substituting direct methods for indirect methods, (5) to perfect field diagnostic apparatus and (6) to tour widely in conjunction with Mechanised Veterinary Officers in first one and then another part of the country.

J. B. Polding.

DR. R. E. M. WHEELER, M.C., D.Litt., F.S.A.

BRIGADIER MORTIMER WHEELER whom we have pleasure in welcoming as Rao Bahadur K. N. Dikshit's successor was, before he went on active service to Tunisia, the Keeper and Secretary of the London Museum, Director of the Institute of Archæology in the University of London, and Lecturer in Archæology in the University College, London. Earlier he was in charge of Archæology in the National Museum of Wales, one of the most progressive among the larger museums of Great Britain. He is an outstanding member of his profession and has a wide range of experience in modern archæological excavation, the preservation of ancient monuments and the organisation of museums. He is a Fellow of the University College, London, Member of the Ancient Monuments Board for England and Wales, and a Governor of the National Museum of Wales. Dr. Wheeler's excavations of Bronze Age, early Iron Age, and Roman sites such as Verulamium, in England and in France are considered to be perfect examples of modern archæological technique. India, particularly Southern India, abounds in megalithic monuments, to which class of archæological remains Dr. Wheeler has paid special attention, and we hope that this branch of archæology will benefit by his knowledge.

Dr. Wheeler is known to be a man of active habits with a great capacity for friendship and team work, and we have no doubt that under his guidance the museum movement in India will be better organised than it is at present, and that Indian archæology will not only maintain the progress that it has made since the days of Sir John Marshall, but help to throw further light on the several unsolved problems connected with the story of India's past.

GLANDS AND GLAND PRODUCTS

III. The Chemical Assay of Desiccated Thyroid

BY

B. B. DEY, P. S. KRISHNAN AND M. GIRIRAJ

(*Chemistry Department, Presidency College, Madras*)

THE results of certain analyses which were carried out in this laboratory on specimens of desiccated cattle thyroid are being recorded in view of the fact that they go to show that the directions given in the British Pharmacopœa (1932) for the desiccation of thyroid are not sufficiently specific. According to the B.P., the minced thyroid gland should be dried at temperatures not exceeding 60° and the dried solid treated for the removal of fat. We had occasion to compare the analyses of a few specimens of desiccated thyroid glands, when the drying was carried out both *in vacuo* and at ordinary atmospheric pressure, the tissues having free access to air in the latter case. A significant amount of difference was noted in the two cases and the analyses were, therefore, carried out on specimens dried also at high temperatures, both *in vacuo* and at atmospheric pressure. The defatting of the dried solid was always carried out with acetone, petroleum ether not being available at present in the market. The results of the analyses which are representd in the following table show conclusively that the figures for the percentage ratio Thyroxine iodine/Total iodine for any given temperature, is consistently higher by a small but definite fraction (see column No. 8) when the preliminary drying is carried out *in vacuo*, than when the same process is carried out in contact with air at ordinary atmospheric pressure. This would seem to indicate that minced thyroid tissue is susceptible to some extent to the action of air at the temperatures used for purposes of desiccation. Preliminary experiments at the actual isolation of thyroxine also go to show that the yield of thyroxine is distinctly higher when the desiccation of the gland material is done *in vacuo* than when it is effected at ordinary pressure.

It would also be evident from the table that with a particular mode of drying, *i.e.*, either *in vacuo* or in contact with air, specimens obtained by drying at high temperatures (80-100°) do not analyse very differently with regard to their percentage of thyroxine-iodine content from those dried at low temperatures (40-60°). Since drying at high temperatures is, however, likely to cause denaturation of thyroid proteins, it seems to be essential that the results of chemical assay of commercial specimens of desiccated thyroid—desiccated thyroid is one of the few gland preparations whose assay is usually carried out *only* chemically—should be supplemented by biological methods of assay for assessing the correct potency.

Cattle thyroid dried *in vacuo*				Dried at ordinary pressure in contact with air			
Temp.	Total iodine per cent.	Thyroxine iodine per cent.	Thy. I/Tot. I in per cent.	Total I per cent.	Thyroxine iodine per cent.	Thy. I/Tot. I per cent.	% difference between colms. 4 & 7
1	2	3	4	5	6	7	8
27°	1·003 1·016	0·4537 0·4444	44·69	Not possible to dry			
40°	1·064 1·046	0·4326 0·4279	40·79	0·9685 0·9752	0·3782 0·3854	39·28	3·844
50°	0·9461 0·9461	0·4130 0·4130	43·62	0·9991 1·021	0·3915 0·3915	38·77	12·51
60°	0·9877 1·007	0·4096 0·4048	40·83	1·032 1·028	0·4030 0·4052	39·23	4·079
70°	0·9028 0·9162	0·4230 0·4265	46·97	0·9982 0·9759	0·3995 0·3971	40·35	16·41
80°	0·9563 0·9372	0·4315 0·4199	44·95	0·9488 0·9385	0·3596 0·3738	38·86	15·67
90°	0·9590 0·9554	0·3897 0·3921	40·84	0·9949 0·9761	0·3588 0·3796	37·46	9·022
100°	1·021 0·9856	0·4078 0·4042	40·49	1·007 1·010	0·3677 0·3654	36·35	11·39

ZOOLOGICAL RESEARCH IN RELATION TO DEVELOPMENT OF FISHERIES*

BY SUNDER LAL HORA, D.SC., F.R.S.E., F.Z.S., F.R.A.S.B., F.N.I.
Director of Fisheries, Bengal

IN inviting me to participate in a symposium on "Zoology and the Food Problem", our last year's President, Dr. B. N. Chopra, wanted me to elucidate "how zoological studies and research can help us in conserving, augmenting and utilising in the best possible way the fishery resources of India". My task has been made much easier by Dr. Chopra himself because in his Presidential Address, he brought out very ably the necessity and importance of scientific research in the development of fisheries. The members will also recall that at the Jubilee Session of the Congress held at Calcutta in 1938, the overseas and the Indian delegates of the Zoology Section reviewed the fisheries of the country in relation to food supplies and felt it necessary to urge upon the Government of India the desirability and "importance of constituting an All-India Department of Fisheries for the development of the fishery resources of Indian waters on scientific lines". The delegates were further of the opinion that, "unless development of the fishery resources of Indian waters is carried out with due regard to the scientific principles which form the basis of successful fishery developments, there will be grave danger of irreparable damage to the fisheries concerned". In commenting on the limited scope of the work done by the Fish Committee of the Imperial Council of Agricultural Research, Dr. Chopra advocated that—

> "Fishery research is a wholetime job and the problems connected with it are too numerous and too involved to be satisfactorily handled as a subsidiary activity of a section of the Imperial Council. Like agriculture, fisheries should have an Imperial Council of Fisheries Research under the scientific control of an expert Fisheries Officer, with a band of scientists working on its staff, with technologists trying to solve the difficulties experienced under varying conditions all over the country, with marketing experts always keen to devise means for better distribution and better utilisation, and with the whole body alive to the ideal of providing 'better food, more food, more and better fertilizer, better organization', and last but not the least, to the improvement in the moral and material conditions of the poor fishermen, for on his well-being will ultimately depend the prosperity of the industry."

Thus, it will be generally conceded that for the development of the fishery resources of India, there is an urgent necessity of undertaking scientific investigations on fishery problems by means of a carefully planned programme of co-ordinated scientific research, which, to be effective and efficient, should be controlled by one central authority for all India. I hope this Session of the Congress will also urge on the Government the necessity and importance of starting a central organisation for research in fisheries.

NATURE OF FISHERY INVESTIGATIONS

Confining myself now to zoological research in relation to the development of fisheries, I wish to invite your attention to the remarks made by the late Dr. N. Annandale regarding the nature of fishery investigations. According to him, these may be considered conveniently under two heads, (*a*) biological and (*b*) human.

"Under the head 'biological', attention must be paid to the physical environment of the fish; to the fish themselves, their species, their life-history, breeding-habits and food, their enemies and, in the case of rapacious fish, their prey.

"Under the head 'human', one must take into account methods of capture, fishery statistics, fishery laws and customs, customs and regulations as to the sale of fish, prices, demand, even the character and social status of the fishermen."

"In all fishery questions it is of the first importance that due consideration should be given to all of these points and neither the human side of the enquiry sacrificed to the biological, nor, as is more common, the biological to the human. Biological training does not give a man local experience; it may not even make him a good judge of character, but still less does local knowledge or administrative capacity enable a man to speak sensibly on technical subjects such as biology without profound study." (*A Note on the Fisheries of the Inlé Lake, Southern Shan States*, Rangoon, 1917, p. 1.)

ZOOLOGICAL STUDIES AND FISHERIES

In the light of these observations, let us now analyse how zoological studies and research can help us in the development of fisheries.

Environment of the Fish.—We all know that environment plays an important role in the life of an organism and that its rate of growth, health, longevity, etc., can be greatly influenced by making suitable alterations and adjustments in its environment, both physical and biological. For increasing the yield of our fisheries, it is necessary, therefore, that all factors that constitute the environment of any particular species should be studied and their influence on its well-being elucidated. For instance, in European countries through the accumulation of a vast body of accurate knowledge regarding the hydrography of the seas, the chemistry and physics of sea-water, its circulation, currents, seasonal changes and fluctuations in the water, and the plankton, both animals and plants, and its annual changes,

* An article contributed to the symposium on "Zoology and the Food Problem" held by the Section of Zoology and Entomology of the Thirty-first Session of the Indian Science Congress, at Dehli, in January 1944.

rapid progress has been made in fishery science and most of the problems which the European fisheries present are now well understood. The problems of the marine fisheries of India are similar and, therefore, for their elucidation a study of all the ecological factors influencing changes in the fish populations is most essential. In the case of freshwater fisheries, it is well known that all pieces of water are not equally productive and that through manuring the tanks and artificial feeding of fish poor tanks can be readily converted into good fisheries. The sources of river pollution and the means to prevent it, and the construction of suitable fish passes in irrigation and hydro-electric weirs to ensure the free movements of migratory fishes are all problems of environment which need a careful study of the habits of fishes at the hands of zoologists before engineers can devise suitable measures for the conservation of fisheries. In all such studies, the role of the zoologists is to correlate the bionomics of any particular species of fish with the physical and biological factors in its environment. There is no doubt that in some cases collaboration and help of chemists and physicists is needed to understand properly the physical environment of a fish, but of late the bases of zoological teaching have been so broadened that several zoologists have qualified themselves for undertaking research in these lines also.

Systematics of Fishes.—The value of the systematics of fishes in the development of fisheries is generally underestimated, but a slight reflection will show that unless we can differentiate species, any real progress in ecology and bionomics of the food fishes is not possible. It is worthwhile to recall that in considering practical measures, which should be adopted for the development of fish industry in India, the *Ad hoc* Fish Committee of the Imperial Council of Agricultural Research in its meeting held in November 1937, expressed the opinion that—

> "In order to effect development upon satisfactory lines, it was necessary to carry out local surveys of the amount and class of fish available and in this connection proper identifications of the fish caught in each area was essential."

I can perhaps illustrate this point better by referring to the Hilsa fishery of India (*Journ. Roy. As. Soc. Bengal,* Science, VI, No. 2, pp. 93–112, 1941). We have found this species breeding under different conditions of salinity right from the deltaic region of the Ganges to as high up as Allahabad. We have also found that the Hilsa of East Bengal is somewhat different looking from the specimens taken from the river Hooghly at Calcutta. So the question naturally arises, are we dealing with one or more species under *Hilsa ilisha* (Hamilton)? On the analogy of Herring-fisheries in European waters and on the basis of our studies, European and American fishery experts have already surmised that there may be different races of Hilsa in our waters which breed under different environmental conditions. Hilsa, as we all know, is essentially a marine fish of the Herring family and, as at present understood, is known from the Persian Gulf, where it ascends into the Tigris river; from the coast of Sind, where it forms an important fishery in the Indus river and the Bay of Bengal whence it ascends into all the principal rivers of India and Burma. It is quite possible that different varieties and races of this species are found in Indian waters, but this point has not been investigated so far. Unless we thoroughly understand the systematics of this species, work on its ecology and bionomics for the proper management of its fishery may prove to be misleading.

It will thus be conceded that taxonomic studies form the bed-rock for all aspects of fishery research and development, and for these studies a sound knowledge of zoological science is most essential.

Breeding Habits and Life-Histories.—It is generally realised that for the development of the fishery resources of freshwaters, the establishment of hatcheries for the restocking of tanks, reservoirs, rivers, etc., and the framing of legislation to prevent interference with the spawning of freshwater fishes and the destruction of fry are some of the necessary measures which should be adopted. In recent years, these very measures have been advocated for the development of some of the marine fishery resources also. Even a very casual consideration of the above-mentioned problems will show the great need of zoological research, for without the knowledge of the breeding habits and life-histories of fishes, administrators are bound to commit several blunders in framing or administering fishery laws. I shall just cite one instance which will make this point clear. In the Inlé Lake, Southern Shan States, Burma, there are several species, about two dozen, which do not attain more than a couple of inches in length. There is an extensive and lucrative fishery of these small fish which yields a handsome revenue to the Government. Some administrator thought that these 'young' fish should be protected but the timely researches of the late Dr. N. Annandale (*Rec. Ind. Mus.*, XIV, P. 33, 1918) showed that these were adult fish and the fishery could continue without causing any deleterious effect to the productivity of the lake. "Close seasons to prevent annihilation of a species should always be based on research into the reproductive habits of the fish in question and disputes between owners of different types of gear can only be settled after attention to research on the swimming habits of the fishes taken by them" (P. E. P. Deraniyagala, *The Fisheries of Ceylon*, p. 8, Colombo, 1932).

The necessity and importance of the studies on the breeding habits and life-histories of all important food fishes for the development of fisheries is so obvious that I need not dwell any further on this point. Suffice it to say that these studies constitute purely zoological research which can be carried out best by specially trained fishery zoologists.

Biology of Fishes.—Under this heading we may consider all problems connected with food, growth-rate, enemies, parasites, migrations, and so on. The question of natural and artificial foods for fishes, especially in fish farms, is of

vital importance. We as zoologists know that all animal actions are determined by three main impulses, search for food, protection from enemy and propagation of the race. Several important fisheries depend upon the relative abundance and scarcity of food and the annual and periodic fluctuations in their yields are mainly influenced by the amount of food available in any particular year.

The biological problems enumerated above are more particularly concerned with freshwater fisheries where large number of fish are very often kept in a limited space, and where growth-rate, food, enemies and parasites can be controlled through the application of approved methods of fish farming. In the case of India the freshwater fisheries are of special significance from the standpoint of ameliorating the condition of the rural population.

"Human" Aspect of Fisheries

It has been shown above that in dealing with the 'biological' investigations connected with the development of fisheries, zoological studies and research have an important role to play. Even for the elucidation of the items listed by Annandale under "human", it will be noticed that a statistician with a zoological training will be able to collect more reliable fishery statistics than a person without any training to differentiate species or without any knowledge of the problems discussed above. For devising more suitable methods of capture, a knowledge of the swimming habits of fishes and the direction of migration will be of inestimable value. Similarly for devising fishery laws or regulations as to the sale of fish, a fair knowledge of the ecology and bionomics of fisheries is essential for suggesting effective measures.

It will thus be seen that for practically every aspect of fish production and conservation, zoological studies and research from the basis of an up-to-date fishery management. However, when we come to the utilisation of the product, zoologists need the help of technologists and marketing experts. Even here much better results can be expected from persons with a certain amount of zoological training and biological outlook.

Importance of Fisheries as a Source of Food

Having discussed the close relation that exists between the development of fisheries and zoological research and in view of the fact that the subject of the symposium is Zoology and the Food Problem, I wish to say a few words about the importance of fisheries as a source of food. As man must get his food either from land or aquatic sources, there are correspondingly two basic food industries, one comprising agriculture and animal husbandry, and the other, fisheries in a broad sense. The aquatic foods have one great advantage that they contain all the essential food elements, such as vitamins, minerals and proteins. It is necessary, therefore, that our fishery resources should be properly husbanded so that in times of emergency, like the present, they can be utilized very fully to supplement the deficiencies and failures of crops and food from the land. In their present undeveloped state, it is estimated that the value or primary production from fishing and hunting is only 120 millions of rupees and that the total catch of fish is 7,000,000 tons which, according to Dr. Radhakamal Mukerjee, yield ·7 billion calories as against the total requirement of the Indian population amounting to approximately 292 billion calories per annum, allowing 2,800 calories per man per day. These data indicate very clearly the great necessity of augmenting the present yield from our fisheries which are potentially very rich.

Importance of Fish in Indian Diet

As fish forms a specially valuable addition to a diet the staple of which is rice, it will be seen that its demand is greatest among the rice-eating population of India. For the same reason, in the countries of eastern and south-eastern Asia, and the adjacent great islands, the fisheries have always been of peculiar importance; since the mass of the people prefer fish to any other form of animal protein. In the north-western parts of India, where wheat forms the staple article of diet, dairy products and meat provide animal proteins in the dietary, while as we proceed eastwards along the Ganges or southwards to the peninsula, where rice forms the staple diet, dairy products become of less importance in the dietary, but fish, oil and root and leafy vegetables are in greater demand. In these parts of India even small fishes, which are good sources of protein, and sometimes of vitamin A, calcium and other inorganic elements, are consumed by non-vegetarian castes in fair quantities. From the dietetic surveys so far carried out in India, it seems that the conservation of fisheries and the greater use of fish as a principal article of diet are indispensable for the health of the nation.

Summary

Attention is directed to the necessity and importance of scientific research in the development of fisheries and it is indicated that nothing effective can really be done in India until there is a central organisation for fishery research. Reference is made to the nature of fishery investigations and it is shown how problems connected with the studies on the environment of fishes, systematics of fishes, breeding habits and life-histories, food, growth-rate, enemies, parasites, migrations and so on are dependent on zoological research for their proper elucidation. Even such items of fishery management as fishery statistics, fishery legislation, marketing, etc., can best be done by persons with zoological training and biological outlook. Thus in practically every aspect of fish production and conservation, zoological studies and research have an important role to play.

Reference is made to the importance of fisheries as a source of food and to the present-day estimated yield from Indian fisheries. The importance of fish in certain Indian diets is also indicated.

LETTERS TO THE EDITOR

TREATMENT OF BLACK WATER FEVER

HAEMOLYTIC substances were demonstrated in the peripheral blood of three patients. They appear a few minutes before an attack of hæmoglobinæmia, and are rapidly removed from the serum by the red blood cells; the hæmolytic properties of the serum can be preserved if the red blood cells are rapidly centrifugalised off (Singh and Singh, 1944).

The hæmolytic process is accentuated by quinine (1 in 300), pamaquine (1 in 1,000) and Mepacrine (1 in 500), and antagonised by antivenine (1 in 300); the latter also antagonises the action of drugs.

The clinical use of antivenene has been attended with complete success; 20 c.c. initially followed by 10 c.c. four-hourly completely cut short an attack of Black Water Fever in thirty-six cases, in which the mortality ordinarily would have been 25-50 per cent. Further in three cases, the administration of Mepacrine in full doses together with antivenine cured the Black Water Fever together with the causative malignant malaria.

Brigade Laboratory,
Allahabad,
March 20, 1944.

INDER SINGH.
INDERJIT SINGH.

Singh, I., and Singh, I., *Ind. Med. Gaz.*, in the press.

RECOVERY OF AGAR FROM USED MEDIA

THE used agar media from vaccine bottles, which is usually thrown away after killing the micro-organisms by autoclaving, was taken and heated in autoclaves to kill any organisms unattacked and coagulate the heat coagulable material. The whole was then filtered hot through two folds of muslin into aluminium 'Degchis'. It was found better to distribute it equally into three or four 'degchis' where it gave a jelly of smaller thickness, easier to wash. The product after gelatinisation was covered with excess of water overnight and in the morning supernatant water was poured off and the hard jelly broken into small pieces and washed with several changes of water. Washing was continued till no more colour came in water (about ten changes of water during four hours).

After this the washed stuff was transferred into a "degchi' and kept soaked in water. The water used for soaking was changed every four hours (about four times overnight) and in the morning the washed agar was put on a filter cloth and water allowed to drain off. Final drops of water were collected in a test-tube and tested for the presence of inhibitory substances with $FeCl_3$ reagent. The formation of turbidity or orange precipitate with a few drops of the reagent indicated the presence of growth-inhibiting substances and in that case the product required further washing. (For getting a negative $FeCl_3$ reaction, four or five quick washings with fresh lots of water were usually sufficient).

The washed agar at this stage was put in a filter cloth, fastened to a wooden frame and as much water allowed to drain off as possible. The product thus obtained was either first assayed for agar content by freezing a known weight of it in the Frigidaire and weighing the dry agar recovered therefrom, thus using the washed stuff straightaway for the preparation of nutrient agar media for vaccine bottles after the addition of required amounts of fresh agar and double strength broth to get a 4 per cent. concentration, or it was melted and filtered into suitable containers and cut into strips on setting and dried in the sun. Alternatively the

solution could be 'frozen' and agar 'isolated' in the usual way.

The recovered agar was found very suitable for bacteriological work on repeated tests. A 3 per cent. solution of this product was enough to give a film of good surface and consistency for the vaccine bottles. Normally a 4 per cent. concentration of commercial Japanese agar is required for this purpose.

The recovery was about 50 per cent.

D. G. Supply
Drugs and Dressings
Directorate,
New Delhi,
March 23, 1944.

B. S. Roy.
J. N. Ray.

A SIMPLE METHOD FOR THE MANUFACTURE OF AGAR-AGAR FROM *GRACILARIA LICHENOIDES*

The following gives a brief account of the simple process of preparation of Agar-Agar (B.P.) from sea-weed.

The dried sea-weed, *Gracilaria lichenoides*, a Rhodophyceæ, is washed free of sand and debris and soaked in a 1 per cent. HCl solution for 15 to 30 feet to remove encrusting and adhering calcium carbonate and washed in water until acid-free. After bleaching and drying in the sun, it is extracted in boiling water successively until the extract fails to jell on cooling. The extracts are combined, cooled to jell and the jelly so formed is cut up into small pieces, placed in a tall cylinder and roughly twice its weight of distilled water added, well mixed and left undisturbed for 48 hours, after which the excess water is strained through a muslin cloth. This process is repeated twice at 24-hour interval and finally the jelly is thoroughly washed and dried. The dried substance is Agar-agar.

The yield of Agar-agar is about 20 per cent. of the dry weight of *Gracilaria lichenoides*. Analytical data of Agar-agar prepared by this method, "Difco" brand Agar-agar, a standard product commonly used in biological laboratories as well as B.P. standards are given below for comparison:

Heads of analysis	Average of several samples	"Difco" Brand	B.P. Standards
	%	%	%
Moisture ..	16	17·48	Not more than 18
Nitrogen ..	0·17	0·22	..
Ash ..	3·60	3·0	Not more than 5
Insolubles ..	0·5	..	,, 1
Setting power	1·0	1·5	,, 1

P. D. Karunakar.
M. S. Raju.
S. Varadarajan.

Government Agricultural Chemist's
Section, Agricultural Research
Institute, Lawley Road P.O.,
Coimbatore,
March 13, 1944.

A NEW SYSTEM OF SOIL NOTATION FOR COMPARATIVE STUDY OF SOIL CHARACTERISTICS

The development of pedology as a science is of recent origin and several systems of soil classification have been put forward. Most of these have been evolved to survey large areas of land on basis of climate, genetic evolution, geological formation, soil colour, crops generally grown, etc., and have probably little practical value, as the variations within the groups so evolved are bound to be great. Soil survey of compact areas as opposed to general topographical surveys has, therefore, its own problems. If the survey is to be of any practical use, the number of samples to be analysed have to be very large and, therefore, the detailed chemical, mechanical and biological analyses have to be abandoned and a simple and effective method of evaluating the factor of primary importance has to be devised. In the revenue classification of soils in this country, the colour of the soil and incidentally soil texture are the only factors used for differentiating soils according to their relative yielding capacities. The texture of the first few inches of the soil and in some places, as in Bombay-Deccan, the depth of the soil over the basic rock are taken into consideration. The primary limitation of soil studies to the surface layers have, however, been rightly modified by recent workers who have shown that profile studies of soil horizons to a depth of three to five feet are very essential to soil classification. A concrete example of how the sub-soil can affect the quality of crops is afforded when the "mail" and "non-mail" rice tracts of Sind are compared. The mechanical analysis of the top layer is of the same order but in the "non-mail" tracts the sub-soils from one to two feet and two to three feet are decidedly sandy as compared to "mail" tracts thus accounting for the inferior quality of rice grown in these tracts. Further, it is now recognised that the field behaviour of a soil is more truly reflected by its aggregate analysis than by an ultimate analysis after mechanical dispersion involving the use of chemicals which act on the soil mass.

The present methods of expressing the different soil characteristics are far from satisfactory as they do not often lend themselves to easy adoption in practice. Thus the orthodox method of giving the values of mechanical analyses to two places of decimal is cumbersome while grouping soils as sand, loam, clay loam, sandy loam, etc., makes only a vague classification. A system of presenting the data of aggregate or mechanical analysis that may commend itself to field workers would be to round off the percentages of sand, silt and clay for each soil horizon to their nearest tens, and after eliminating the end zero, combine them to give a three figure number, which would denote the particular horizon. Thus at a glance it is possible to grasp the approximate textural composition of the soil and compare it with others without confusion. A number like 721 would, for instance, denote that the soil has 65 to 74·9 per cent. sand, 15 to 24·9 per cent silt and 5 to 14·9 per cent. clay. The

advantages of this representation are obvious.

This system of representation is elastic and any other data of importance could be associated with the index by appropriate number or alphabet. Thus the influence of climate can be incorporated with the soil index showing the textural composition. It has been shown in this laboratory that Meyer's factor, *viz.*, rainfall divided by absolute saturation deficit of the air, the latter being given by the formula:

100 — Relative humidity/100 × Mean vapour pressure (m.m.),

calculated from the meteorological data of research stations distributed all over India brings out the climatic variations and conforms with the climatic classification for soils into arid, semi-arid, humid, and per-humid zones. If this single value climatic factor is associated with the numerical index of soil texture the information conveyed by the index is greatly augmented. For associating the Meyer's factor it is modified by rounding to the nearest ten and eliminating the last zero so that brevity, so essential in such numeric representation, could be maintained.

In addition to the association of Meyer's factor with the index, the colour classification of the soils can also be associated likewise. Without attaching much importance to fine variations, the soil colours may be classified into the following groups, of which the initial letter or letters may usefully be associated with the numerical index: (1) Red (R), (2) Black (B), (3) Grey (G), (4) Brown (Br) and (5) Yellow (Y).

The following table gives the results of analysis of a few typical soils from various research stations together with an expression, in the last column, of these results by the above nomenclature. It may be seen that the comparative evaluation of soils is made simple by the adoption of the proposed system.

Locality	Aggregate analysis			Meyer's factor	Soil index
	Sand	Silt	Clay		
Black soils—					
Akola ..	39·6	40·4	0·0	141·4	B. 442·14
Labhandi ..	34·6	48·6	16·8	237·2	B. 352·24
Hagari ..	39·6	32·5	27·9	91·3	B. 433·09
Padegaon ..	35·2	38·4	26·4	132·3	B. 443 13
Red soils—					
Ranchi ..	60·2	31·7	8·1	318·1	R. 631·32
Taliparamba ..	52·1	31·3	16·6	753·9	R. 532·75
Coimbatore .	67·2	20·0	12 8	162·0	R 721·16
Sirsi	72·7	21·8	5·5	666·5	R. 721·67
Grey soils—					
Delhi .	72·9	19·6	7·5	123·7	G. 721·12
Kangra ..	59·5	34·8	5·7	676·0	G. 631·68
Shahjahanpur ..	81·6	15·6	2·8	205·3	G. 820·21
Karimgang ..	40·6	51·6	7 8	132·8	G. 451·13
Chinsura ..	18·[illegible]	62·8	8·5	426·6	G 202·43
Samalkot .	65·9	23·4	10·7	223·0	G. 721·22
Tabiji ..	90·2	7·4	2·4	110·2	G. 910·11

It is possible, on the same basis, to work out chemical indices for soils. Thus a soil containing 42 mgm. of N, 54 mgm. of P_2O_5 and 200 mgm. of K_2O could be represented by $N_4P_5K_{20}$ which would be a very suitable index for comparative purposes. Similarly, values for soil reaction and exchangeable bases can also be suitably abbreviated and added to this index wherever these values are known to influence crop yields.

The system of notation suggested here can be improved upon or modified to suit the individual problems of the soil surveyor. An agreed notation on these lines would greatly help in comparative soil studies and ultimately in all soil-crop relationships.

Imperial Agricultural Research Institute, New Delhi,
March 20, 1944.

S. V. Desai.
N. D. Vyas.
K. C. Batra.

MANUFACTURE OF GLAND PRODUCTS

The interesting article by Prof. B. B. Dey and his associates[1] has brought out much useful information which has a bearing on the utilisation of gland products under Indian conditions.

We have collected considerable amount of data bearing on the utilisation of pituitary and other glands, but owing to certain technical considerations, we are precluded from publishing all the related details.

Pituitary Gland

During the past fifteen months, we have processed pituitaries from about two lakhs of animals. We have further built up an organisation which is now dealing with a number of slaughteries and is handling about 20,000 glands per month.

We have concentrated chiefly on the beef glands, which are the only ones of practical value, particularly for the manufacture of post. pituitary powder. In our experience, the average weight of the glands varies from place to place in India, being dependent on the size of the animals which, in turn, is dependent on soil and climatic conditions. Thus, in a Western India centre, the average pituitary weighs over 2 grams, whereas at a South Indian centre, glands weighing less than 0·8 gram each are obtained. Irrespective of the location of the centre, one occasionally comes across a gland in which either the posterior or the anterior lobe preponderates.

In actual production, the average ratio of the separated posterior lobe to the residue (chiefly representing the anterior lobe) works out to about 1: 5. This is largely because some of the posterior lobe is left behind in the dissection. A certain amount of skill and speed is required in the manipulation because, after some time, the line of demarcation between the two lobes becomes rather blurred.

Experience has shown that a great deal of the earlier theory and practice in regard to the handling of the gland material, as also some of the concepts in regard to the stability of the hormone components, require revision. The active principles are comparatively stable, but there is apt to be much loss in handling. It is

particularly so when the gland materials have to be transported from one centre to another.

The final yield of the post. pituitary powder is determined by a number of factors including the skill of the operation. In some centres about 70 glands are required to yield one gram of the finished powder, while at others, even 25 to 30 glands are sufficient to yield the same result. The practical success would naturally depend on obtaining as favourable a ratio as possible.

We have carried out numerous assays on the products prepared by us. Practically every batch has been found to conform to the new International Standard. Our results have been independently confirmed by our colleagues at other centres. We can now state, with a certain amount of confidence, that, with necessary care and control, a product conforming absolutely to the new International Standard can be produced on a large scale in India.

THYROID GLAND

We have processed useful quantities of beef as well as sheep glands and have supplied the material for certain emergency requirements. The process offers no difficulty. The final product which was derived exclusively from one centre was found to contain about twice the amount of iodine (in combination as thyroxine) as that prescribed according to B.P. Standard. This may not, however, apply to other centres, so we refrain from generalising on this point.

The use of the thyroid in medicine is limited and the average medical practitioner seldom prescribes it. Fairly large quantities of the desiccated gland are, however, being prepared in different parts of the world (as also in India) and the major part of this material as also other whole gland materials go to make up certain rejuvenation remedies of a doubtful value.

N. N. DE.
N. L. LAHIRY.
V. SUBRAHMANYAN.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
March 17, 1944.

1. *Curr. Sci.*, 1944, **13**, 35.

ADRENAL GLANDS

WE have been primarily interested in the production of *l*-adrenalin and have concentrated chiefly on beef glands as being of practical value. We have handled about 50,000 glands at one centre with a view to standardising the method of production.

We have occasionally found the absolute adrenalin content to be as much as 3 mgm. per gram of fresh tissues, but the average is about the same as that stated by Prof. Dey and his associates. Our earlier average yield was 1·8 gram per kg., but by improving the method of extraction, we have lately been able to raise it to 2 grams. The products prepared by us have been assayed by us and independently by a colleague at another centre and found to conform (within limits) to the standard.

There has been a certain amount of controversy regarding the relative merits of natural and synthetic adrenalin, with a strong section of medical opinion in favour of the former. From the economic point of view it is usually assumed that the natural product cannot hope to compete with the synthetic one, but this opinion is not justified. If the glands can be obtained at a reasonable price, adrenalin from the gland can be made at a lower cost than by synthetic method. Apart from the usually well-known precautions to ensure the stability of the hormone, effective extraction from the glands is an important factor determining the success.

N. N. DE.
K. V. KAMATH.
V. SUBRAHMANYAN.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
March 17, 1944.

UPPER JURASSIC MARINE ALGÆ FROM TRICHINOPOLY, S. INDIA

THE discovery of *Solenopora* in the Cullygoody limestone was reported by me on a previous occasion,[1] and two species, *S. jurassica* Nich. and *S. coromandelensis* S. R. N. Rao were figured and briefly described. A detailed account which has since been completed is now ready for publication. The marine flora recorded is a small one, but of exceptional interest: for the first time, it establishes a Jurassic horizon in the Trichinopoly area; and it has an important bearing on the age of the Upper Gondwanas of this region. The species present are listed below and the stratigraphical results arrived at briefly discussed.

The genus *Solenopora* has world-wide distribution and its range is from the Ordovician to Jurassic.[2] The Cullygoody algæ provide critical evidence for an Upper Jurassic age; they are very similar to marine floras from the Jurassic of other parts of the world.

The plants as a whole are definitely archaic; the algal vegetation of the world took a modern aspect in the Lower Cretaceous when true Corallinaceæ (with *Archæolithothamnium* as the earliest representative) first appeared—shortly after *Solenopora* and other ancient genera had become extinct.

Besides the algæ, thin sections of the limestone occasionally show indeterminate fragments of a land plant and some arenaceous foraminifera. The latter consist mostly of *Choffatella* whose age is Lower Jurassic to Lower Cretaceous.

It is interesting to note that a Jurassic alga (*parachætetes*) has already been recorded by Dr. Pia from the Danian Niniyur beds of the Trichinopoly area.[3] This genus is not known to have survived the Upper Jurassic in other parts of the world. I have some reasons to believe that it is a derived fossil in a Danian matrix; palæontological anachronisms of this kind are frequent in the Trichinopoly area.

The Cullygoody limestone[1] is correlated with the Coral reef limestone (the basal member of

Cullygoody Algæ: Geographical and Stratigraphical Distribution

	Perm.	Trias.	Lias.	Oolite.	L. Cret.	Up. Cret	Eocene
S. coromandelensis S. R. N. Rao ..							
S. jurassica Nich.				E, Fr.			
Marinella jurassica Pfender ..	Nm.		Sp, Sy.	M, J.	A.		
Symploca jurassica Framey & Dangeard			Sp.	Fr, C, Mg.			
Pseudolithothamnium alba Pfender ..					C, Sy, Sp.	Fr.	An, B., Mg.

A = Angola. C = Carpathians. J = Japan. Nm = New Mexico.
An = Anatolia. E = England. M = Moravia. Sp = Spain.
B = Baluchistan. Fr. = France. Mg = Madagascar. Sy = Syria

the Utatur series) and considered to be Albian in age. In view of the discovery of *Solenopora* in this limestone, its relationship with the Utatur series needs further examination. The Coral reef limestone, it may be noted, rests directly on the Archæans and in some places Upper Gondwana plant beds intervene between the two.

Department of Geology,
Intermediate College,
Bangalore, S. R. NARAYANA RAO.
February 2, 1944.

1. Rao, S. R. N., *Palæobotany in India*, *Prog. Rep.*, Lucknow, 1942, **4**, 178. 2. *Solenopora urgoniana* Pfender described from the Lower Cretaceous of France differs markedly from the Jurassic *Solenopora* as admitted by the author (*Bull. Soc. Geol. Fr.*, 1930, **30**, 104) and it is probably a *Petrophyton*. *Solenopora rothpletzi* Yabe (*Metasolenopora rothpletzi* Yabe) stated to be Lower Cretaceous by Dr. Pia (Handbuch der Palæobotanik, 1927) is really Upper Jurassic (see Yabe and Toyama, *Sci. Rep. Tohoku Imp. Univ.*, **1928**, **1**, **3**). 3. Rama Rao and Pia, *Pal. Ind. n. s.*, **1936**, **21**, No. 4. 4. Blanford, H. F., *Mem. Geol. Surv. Ind.*, 1862, **4**; Rama Rao, 'The Cretaceous rocks of Sonth India', *Lucknow Univ. Studies*, **1942**, **17**.

ON THE PRODUCTION OF TRUE PILEI OF *POLYPORUS BRUMALIS* (PERS.) FR. IN ARTIFICIAL CULTURE

THE exact conditions under which a fungus will produce sporophores on artificial media is still an open question. Buller[2] has tackled the problem mainly with the Agarics. Many other workers during recent years have tried to throw light on the subject but no definite conclusions have yet been arrived at.

Polyporus brumalis was growing saprophytically on a dead log in Calcutta, in July, 1942. A fresh fruit-body was collected and spore-deposits were taken on sterile agar plates from which several polysporus cultures were made in culture tubes (6″×½″) on Potato-dextrose agar, Oat-meal agar, Malt-extract agar, and Brown's Potato-starch agar. These cultures were then kept in an inclined position and subjected to different conditions of temperature, namely, constant temperatures of 22° C. and 33° C. and a variable temperature of 23°-27° C. of the laboratory. Under these conditions, again, the cultures were kept in complete darkness as well as in diffused light. In all cases, however, germination of spores started within 24 hours.

All young cultures at first developed a felty mat which later on became appressed and sub-felty. Stalks of fruit-bodies appeared in several cultures under the aforesaid different conditions. The first culture to fructify was on Oat-meal-agar kept in diffused light and at 33° C. (Fig. 1) in about a month. In this particular case, three rudimentary stalks appeared at the base of the tube when the original position of the tube was altered and made vertical. Subsequently, it was observed that the growth of two stalks was checked while the third one continued its upward development. In no case, however, pileus was formed. Later on, similar stalks developed in tubes kept in other conditions including those placed in complete darkness. The treatments suggested by Long and Harsch[3] were made for *Polyporus brumalis* but without any success. By allowing the light to fall on the top and none from the sides, the stalks of the fruit-bodies elongated in the direction of light proving that they are positively phototropic. The upward growth of the stalks is purely incidental and has no relation to gravity. This was shown in culture-tubes which were kept in a horizontal position and the vertical stalks arising at the base of the tubes soon turned their apices and grew horizontally parallel to the glass surface. To see whether lowered humidity in the culture-tubes due to age was preventing pileus-formation, a few drops of sterile distilled water were introduced aseptically into the culture-tubes from time to time but with no desired result.

It appeared to the authors that aeration might possibly be the factor preventing pileus-formation in this case, since in such closed culture tubes, the space was limited and consequently the aeration affected. Several cultures were then made on the new medium advocated by Badcock[1] in Erlenmeyer flasks of 1,000 c.c. capacity each. A good growth was obtained in all of them. A stalk of the fruit-body developed in about a month which elongated and branched repeatedly. The surfaces of such stalks were not smooth but had numerous

foldings. The tip of the stalk reached the base of the plug and there remained as such without forming any pileus. But as soon as the plug was opened, the stalk elongated, reached the neck of the flask and then formed a normal pileus (Figs. 2 and 3).

FIG. 1

FIG. 2

FIG. 1. Stalks of fruit-bodies arising from the base of the tube.

FIG. 2. Formation of a normal pileus at the mouth of the flask when the plug is opened.

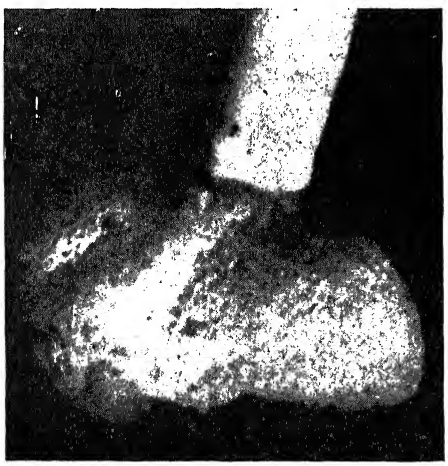


FIG. 3

FIG. 3. A magnified view of the pileus showing pore-mouths.

Thus, the conditions under which normal fruit-bodies of *Polyporus brumalis* developed in artificial culture could be determined from the above experiments. That light has no direct effect on sporophore-production is universally true and this had also been proved for the fungus under discussion. Temperature seems to have little control over the formation of fruit-bodies for sporophores developed in cultures irrespective of different temperatures. The relation of humidity to sporophore-production in culture-tubes is also not conclusive, for, the addition of sterile distilled water to cultures had no effect upon them. It might seem, at first, that the accelerator in Badcock's medium was responsible for pileus-formation. A mycelium never forms fruit-bodies until its hyphæ have accumulated from the substratum sufficient food material to ensure that any reproductive effort shall not fail through lack of food material. Badcock's medium offered a rich growth for the fungus in that sense but the factor retarding the formation of pileus was aeration. This was proved on observing that the pileus formed only when the plug was opened, when this stipe grew in length, reached the neck of the flask and receiving oxygen supply formed the normal pileus. In such closed culture-tubes where the mycelium is vigorously respiring, the atmosphere within, naturally becomes toxic due to accumulation of CO_2, and it is probable that if oxygen be supplied to these cultures from time to time, this toxic effect will be neutralised and fruit-bodies will be formed. Observations supporting this are now being made with other fungi and special devices are made for supplying oxygen. The results of these investigations will be communicated elsewhere later on.

Our sincere thanks are due to Prof. S. P. Agharkar, Head of the Department, for the facilities given.

SACHINDRA NATH BANERJEE.
BIMAL KUMAR BAKSHI.
Department of Botany,
Calcutta University,
December 13, 1943.

1. Badcock, E. C., "New methods for the cultivation of wood rotting fungi," *Trans. Brit. Myc. Soc.*, 1941, **25**, 2. 2. Buller, A. H. R., *Researches on Fungi*, Vols. 2 and 4. 3. Long, W. H., and Harsch, R. M., "Pure cultures of wood-rotting fungi on artificial media," *Jour. Agri. Res.*, 1918, **12**, 2.

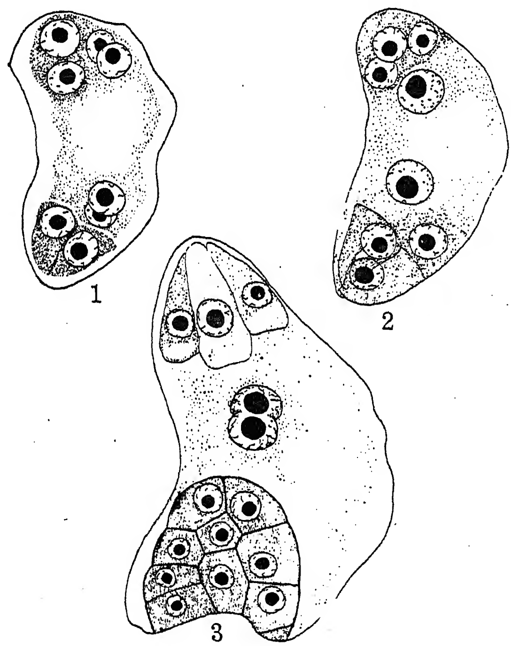
A REINVESTIGATION OF THE EMBRYO-SAC OF *ERAGROSTIS CILIANENSIS* (ALL.) LINK.

STOVER (1937) first investigated the development of the embryo-sac of *Eragrostis cilianensis* (All.) Link., and reported an extremely interesting organisation of the micropylar group of four nuclei of the eight-nucleate embryo-sac, which is developed in the normal manner. According to him, one egg, one synergid and two polar nuclei are organised by the micropylar group of four nuclei. Regarding this work Maheshwari (1941) wrote: "Unfortunately the figures are not convincing and a reinvestigation of the plant is necessary before his interpretations can be accepted." For reinvestigation authentic seeds of the species were obtained by the kind courtesy of Prof. L. S. S. Kumar, Agricultural College, Poona. The plants were grown locally and the material was collected from these.

The development of the nucellus, integuments and ovule proceed in the same manner

as has been described by Stover (1937). As he has already recorded, the primary archesporial cell does not cut off any parietal cell, a T-shaped tetrad of megaspores results after the reductional divisions; the lowermost megaspore develops further. Upto the third division of the megaspore nucleus Stover's observations are in agreement with those of the writer.

Soon after the formation of four nuclei at each pole of the embryo-sac, one can see the characteristic large vacuole separating the two groups of nuclei. First, the plasma around the two nuclei lying nearest to the chalaza becomes dense and soon gets separated as two antipodal cells. When this is complete, a similar phenomenon is seen in relation to two of the nuclei at the micropylar end also. Fig. 1 represents the embryo-sac at about this stage. At



FIGS. 1, 2 and 3. × 480. For explanation see text.

a slightly advanced stage, only one of the other two free nuclei of the chalazal group becomes embedded in dense plasma, and the other nucleus remains free and slightly increases in size. This process repeats more or less simultaneously at the micropylar end also and the nucleus thus separated becomes conspicuous by its slightly enlarged size (Fig. 2). These two free nuclei, one at each pole of the embryo-sac, constitute the respective polar nucleus. They move towards each other until they unite and fuse (Fig. 3). The fusion is completed before fertilization and the fused diploid nucleus lies nearer to the egg apparatus. The remaining three nuclei at the micropylar end becomes organised into two typical synergids and one egg. The egg is slightly larger and possesses a similar nucleus.

The nuclei of the three antipodal cells, soon after their formation, undergo prophasic changes for further divisions. Stover observed that only one or two of the antipodal cells divided further resulting in five or six cells. The present investigation, however, clearly shows that all the three antipodal cells take part in increasing the number of antipodal cells. Most of the mature embryo-sacs showed as many as twelve cells forming a compact mass (in Fig. 3 only nine such cells are shown, as the other three cells were in the next serial section of the slide). This mass of antipodal tissue degenerates after fertilization.

It will be evident from the preceding account that the development of the embryo-sac in *Eragrostis cilianensis* (All.) Link., is quite typical, except for an increase in the number of the antipodal cells which is a dominant tendency among the members of the family. Hence, Stover's claim, that the organisation of the embryo-sac in this plant "is a new type not only for the grasses but for all plants", becomes invalid.

Basavangudi,
Bangalore,
March 14, 1944.

B. G. L. SWAMY.

Maheshwari, P., *Jour. Ind. Bot. Soc.*, 1941, **20**, 229–61. Stover, E. L., *Ohio. Jour. Sci.*, 1937, **37**, 172–84.

A NEW AMPHIBIAN TRICHOSTRONGYLID

TRICHOSTRONGYLIDS which form an important group of Nematodes are of rare occurrence in the Amphibia. The well-known genus *Oswaldocruzia* has been described from several parts

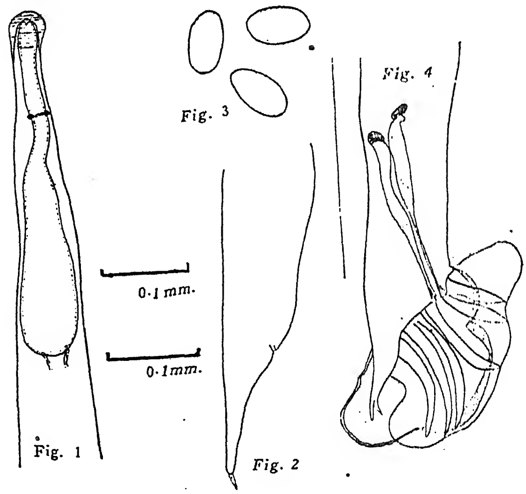


FIG. 1. *Oswaldocruzia indica* n. sp. Female, anterior end.

FIG. 2. *Oswaldocruzia indica* n. sp. Female, posterior etd.

FIG. 3. Eggs of *Oswaldocruzia indica*.

FIG. 4. *Oswaldocruzia indica* n. sp. Male, posterior end showing spicules and bursal rays.

of the world from amphibian hosts but in India its occurrence was not reported till 1942[1]

when the writer obtained a few specimens of *Oswaldocruzia* from the intestine of the common toad, *Bufo melanostictus* at Lucknow. Further search for these parasites was continued and the genus *Oswaldocruzia* is now being reported from *Rana cyanophlyctis* as well, although the frequency and percentage of infection in both *Bufo* and *Rana* are extremely low.

The worms are very thin and white or whitish-grey in colour, and do not show great mortality in life. The head has a distinct cuticular inflation which shows transverse striations. The lateral membranous wings are absent. The cervical papillæ are present. The following table gives the measurements (in millimeters) of the male and female specimens:—

	Male	Female
Length ..	4·9	10·9
Width maximum ..	0·1	0·23
Head inflation length ..	0·03	0·05
Œsophagus length ..	0·3	0·42
Head nervering distance	0·12	0·135
Anus tail (including spike) distance ..		0·18
Vulva tail distance ..		3·8
Spicule length ..	0·22	
..	0·20	
Eggs	0·075 — 0·08 × 0·04 — 0·05	

Host: *Bufo melanostictus; Rana cyanophlyctis.*
Locality: Lucknow, U.P., India.

Discussion

The genus *Oswaldocruzia* was erected by Travassos (1917)[2] and since then quite a large number of species have been added to the genus. Recently Walton (1938)[3] gave a summary of various amphibian species of this genus. Later Freitas and Lent (1938)[4] described one species from Rio de Jenero, Brazil; and Koo (1939)[5] added another species from Canton, China. The genus was split up into two sub-genera *Oswaldocruzia* and *Bialata* by Morishita (1926)[6] on the basis of the presence or absence of lateral membranous wings although this distinction has not been rigidly followed by later workers. The important amphibian species[7] of the sub-genus *Oswaldocruzia* are as follows:—

1. *Oswaldocruzia* (*Oswaldocruzia*) *filiformis*.
2. ,, ,, hoepplii.
3. ,, ,, leidyi.
4. ,, ,, mazzai.
5. ,, ,, *waltoni*.
6. ,, ,, lopesi.
7. ,, ,, *heparia*.
8. ,, ,, subauricularis (Type species).

The present form does not bear lateral expansions of the body and hence may be put under the sub-genus *Oswaldocruzia* (*Oswaldocruzia*) according to Morishita. It differs from the species *heparia*, *hoepplii*, *mazzai*, *waltoni*, *leidyi* and *lopesi* in having much larger spicules in the male in proportion to the size of the body and also in the size of the eggs and the œsophagus. The present form comes nearest to the species *filiformis* and *subauricularis* but from both these it differs in the shape of the spicule and the dorsal ray and in having smaller eggs. It is, therefore, regarded as a new species to which the name *Oswaldocruzia* (*Oswaldocruzia*) *indica* is given.

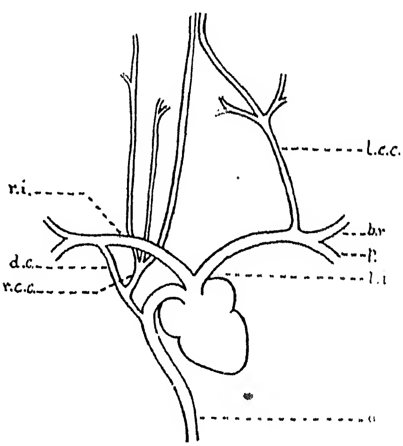
Lucknow University, M. B. Lal.
February 2, 1944.

1 Lal, M. B., *Curr. Sci.*, 1942, **2**, No. 8. (One species from Nicobar islands was described by Baylis and Daubney, *Rec. Ind. Mus.* Calcutta, 1923, **25**). 2. Travassos, *Braz. Medic.*, 1917 **31**. 3. Walton, *Trans. Amer. Micros. Soc.*, 1938, 57-(1). 4. Freit s and Lent, *Mem. Inst. Oswal. Cr.*, 1938, Tom. 33, Fas. 4. 5 Koo, *Ling. Sci., Jour.*, 1939, **18**, No 2. 6. Morishita, *Jour. Fac. Sci. Imperial Uni. Tokio*, 1926, **1**, part I, 7. Travassos, *Mon. Inst. Oswal. Cr.*, 1937, 1-vii.

PERSISTANCE OF DUCTUS CAROTICUS AND THE UNUSUAL ORIGIN OF THE RIGHT COMMON CAROTED IN THE PIGEON

An unusual abnormality was noticed by me in a dissection of the pigeon which is worth recording for its rarity. Previous records of abnormalities in the arterial system of birds including pigeon relate to the persistence on the right side, of a vessel, the ductus caroticus connecting the common carotid artery with the systemic or aortic arch. These are all obviously cases of a persistent embryonic condition in the adult.

In the specimen of pigeon dissected by me, while the ductus caroticus persisted as in the previous cases recorded, the common carotid of the right side, instead of arising as in those



Ventral view of the arterial arches of pigeon
br.—brachial artery; *d.a.* dorsal aorta; *d.c.* ductus caroticus; *l.c.c.*—left common carotid artery; *l.i.* left inromirate; *p.*—pectoral artery; *r.c.c.*—right common carotid artery; *r.i.*—right inromirate.

cases from the innominate (Brachiocephalic), was given off from the ductus. From the ductus

arose a common trunk which soon divided into three branches corresponding to the three branches on the left side of one of which is the common carotid.

The points of interest in this specimen are:—

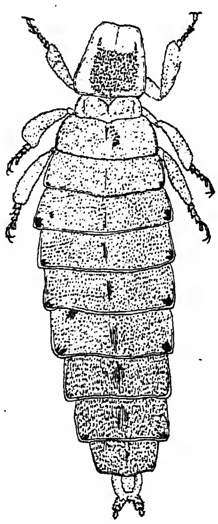
1. The ductus caroticus did not connect the carotid and the systemic; on the other hand, the carotid arose from it.
2. The innominate of the right side consequently represents only the subclavian of that side and the ductus connects the subclavian with the aortic arch.
3. The unusual and embryologically unexplainable origin of the right common carotid from the ductus.
4. The right common carotid arising from the ductus gives off its two branches at a much lower level than does the left carotid.

Zoology Laboratory,
Presidency College,
Madras, (MISS) C. K. SUBHAPRADHA.
February 1944.

AN ADULT FEMALE LAMPYRID FROM PAMPADAMPARA, S. INDIA

THIS paper is based on three specimens collected and sent to me from Pampadampara, N. Travancore, in February 1942, by Mr. C. J. Selvaraj. These forms appear to be rare and as I am not aware of any previous description it is extremely difficult to identify. Most probably this is an undescribed female of an already known male. As Mr. J. C. M. Gardner writes to me, very little is known of Indian Lampyrids and it appears impossible to determine females and almost impossible to determine males with certainty. Very little work has been done on the systematics of Indian Lampyridæ and the family requires a thorough revision.

Length: About 40 mm.
Colour: Creamy white.



Female Lampyrid from Pampadampara

Head is retracted into the prothorax. Head capsule is broader than long and bears dorsally two brownish longitudinal striæ and laterally two large black compound eyes. The antennæ spring apically from the narrow preocular region of the head. Dorsally the posterior margin of the head-capsule carries a median rounded lobe. Ventrally the head-capsule is bridged by a broad thin gular plate, which occupies the posterior half only. The hypostomal ridges are parallel and bear anteriorly the acetabula for the articulation of the mandibular postartis. Labrum is a median lobe devoid of any distinct sutural demarcation from the rest of the head-capsule. It is slightly notched at the free margin and carries a fine marginal brush of hairs. The antennæ are 11-jointed[1] and finely setose with the basal joint largest and basally constricted; second shorter than third which is longer than any of the remaining joints except the basal. Mandible is considerably reduced to a flat lobe carrying externally a row of long hairs and internally a dark cutting edge with a brush of very short hairs. The apex is rounded and provided with a minute mucronate spine. The gular plate is basally broader, laterally inflexed and each anterolateral apex is produced into a long process directed vertically upwards into the head. Anteriorly the gular plate gives articulation to the cardines and the post-labial sclerite. Cardo is small. Stipes bears anterolaterally a Palpifer which carries the 4-jointed maxillary palp, basal joint of which is small, second and third distally wide, while the apical is large and compressed along the inner anterolateral margin which is provided with a dark spot. The galea is dorsal, white, cylindrical and setose. The labium is narrow and strengthened posteriorly by a post-labial sclerite whose posterior half is more sclerotised than the setose anterior half. Palpigers are present and they bear the 3-jointed labial palps. Ligula is represented by two whitish cylindrical structures.

Thorax.—Pronotum is slightly broader than long and sinuate anteromedially with the anterolateral margins rounded, posterior margin wavy, median carina feebly emphasised and disc convex and diaphanous anteriorly. Mesonotum is conspicuously smaller and anteriorly differentiated into a prescutal area by a strong suture. Metanotum is considerably broader than the mesonotum and the median carina very feeble. The plates are clothed uniformly with short fine hairs and sometimes irregularly wrinkled. The legs are devoid of spines so characteristic of the lampyrid larvæ but densely clothed with fine hairs. Coxa is large, coxo-trochantral articulation dicondylic and movable, trochantero-femoral joint immovable, trochanter undivided, femur long and more or less dilated, tibia almost as long as femur with its outer edge foliaceously dilated and longitudinally grooved, tarsus pentamerous, subapical joint being bilobed and apical bearing a pair of claws.

Abdomen.—Eight terga and eight sterna are visible. Sixth and seventh sternal plates are 'eburated' and together constitute the photogenic organ. Segments 9 and 10 are modified

into a soft genital tube telescoped into the preceding segments. Posteriorly a pair of minute anal appendages occur, each with a stout cushion-like basal joint and a small chitinised setose apical joint. The tergal plates are devoid of the median longitudinal channel or sulcus and their margins strongly ribbed. The second abdominal plate (DP_2) is the broadest plate. The sternal plates are rectangular and devoid of spines. The eighth sternal plate is small and not rectangular. The spiracular sclerites are continuous with the sterna, but separated by strong wrinkles. The whole interior of the trunk is loaded with the massive ovary. Although the ovary appears as a single extensive mass, the oviducts are paired and distinct as in the adult female *Lamprophorus tenebrosus* Wlk.

Department of Zoology,
Christian College,
Tambaram,
Madras, J. SAMUEL RAJ.
March 6, 1944.

1. In one of the specimens examined the apical joint was distinctly sub-divided dorsally so as to make up the antenna 12-jointed, but not so ventrally.

ON THE OCCURRENCE OF DIAPAUSE IN THE EGGS OF INDIAN CYPRINODONTS

RECENTLY, while going through the article of George S. Myers[1] on "Studies on South American Fresh-water Fishes", I came across the following interesting remarks on the Cyprinodone fishes of the genus *Cynolebias**:—

"The fishes of this genus are now known, through the works of aquarists and aquarium collectors, to be annual fishes which complete a full life-cycle within one year. They are rare or absent in ordinary streams and permanent lakes and ponds, being common only in isolated water-holes, swamps and puddles that dry up in the dry season. The fishes require a deep mud bottom. The eggs which are very tough-shelled and resistant, are deposited in the mud when the ponds have begun to dry up. The adult population is wiped out upon the complete drying of the ponds and the species exist over the dry season only in the egg stage, buried in the damp mud under the hardened top crust. Advent of the wet season, with accumulation of water in the ponds and the softening of the mud initiates the hatching of the eggs. Development of the fry is exceedingly rapid, for in some instances full growth is attained in two or three months. .... Certain African species, *Aphyosemion cœruleum* for one, as well as several species of *Nothobranchius*, also are short-lived, and produce tough eggs which, in the few instances in which the fishes have been bred have been found to take one to several months to hatch. It is probable that these species, especially *Nothobranchius* from the drier plains of East Africa, are annual fishes."

Some time ago, while making observations[2] on the breeding and development of *Oryzias melastigma* (= *Aplocheilus melastigma*), I found that especially during the hot seasons if the water in the aquarium was not replenished the hatching time of the eggs was unduly prolonged. This phenomenon was rather puzzling since under similar conditions the eggs of other fishes did not show any remarkable difference in the incubation period. It was seen in a number of instances that some of the eggs of *O. melastigma* kept in a vessel would hatch out within the normal period of 8 to 14 days whereas the rest would remain with healthy embryos for weeks together except a few that died. Instances of diapause up to six weeks have been observed by me. No records were taken of the incidence of this phenomenon during the different parts of the year and observations were not conducted under natural conditions. The delay in hatching has never been consequent on the slowness of development as both in the early and late hatchers the rate of development of the embryo has been the same and it was the fully developed 'ready to hatch' larva that was in a state of diapause. Perhaps the only difference between the fry of the two sets was that in the early hatchers the larva possessed a little yolk, less of pigmentation and fewer fin-rays. Another interesting fact observed in the case of the eggs of this species is that if fresh-water or water of much lower salinity is added the eggs would hatch and quite normal and healthy larvæ would immediately come out. Sometimes such eggs were removed one by one into a petri-dish and just to watch the fry coming out, a jet of water was directed on to them from a pipette with the desired result. The reason for this could be explained to the sudden change in osmotic pressure due to the addition of fresh-water making the egg membrane burst since in all instances the water in which the eggs were kept was from the brackish water areas of the Cooum and Adyar, Madras. In natural conditions also the principle involved in the hatching of the eggs should be similar.

Though it appeared to me even then that this state of diapause during the egg period may be a sort of natural provision to tide over unfavourable conditions and ensure a copious supply of fry by the onset of the rains, when conditions become ideal for growth and migration, it was dismissed as rather a premature conclusion and only remarked that in some cases the hatching period has been found unduly prolonged.[2] It is clear now that this view is correct and though Indian species might not have developed such a degree of

* Since sending this note for publication I was able to go through "*Tropical Fishes for the Home: Their Care and Propagation*" by F. H. Stoye (New York, 1935) in which interesting accounts on the breeding of the fishes of the genera *Aphyosemion*, *Nothobranchius* and *Cynolebias* are given.

specialization as the American and African species, this may be an incipient tendency towards that condition. The capacity of the eggs of Cyprinodonts to lie dormant during unfavourable season in stagnating water would certainly enhance their suitability as larvicidal fishes.

Regarding *O. melastigma*, Job[3] says that "At Calcutta they hatched out in eleven days in water at 88° and in fourteen days in 85°. A few eggs kept in a vessel without change of water hatched out in nineteen days". In the case of other Cyprinodonts some variations in the incubation period are recorded by Job[3] in *Aplocheilus panchax* and by Kulkarni[4] in *Horaichthys setnai*.

The views of some of the former workers on this subject are as follows. Tennent[5] in his *Natural History of Ceylon* refers to the belief that eggs of many tropical fishes are able to tide over the dry season in the mud and gives reasons against such a possibility. He is of opinion that the mature fish bury themselves in the mud under the hardened top crust and come out ready to spawn at the advent of rains. Thomas[6] emphasizes the need for more work for studying the capacity, if any, of the eggs of tropical fishes to æstivate. Day,[7] in the absence of any definite data, declines to make any comment on the view that fish full of spawn are able to æstivate till the commencement of the next rains.

I am indebted to Dr. George S. Myers of the Stanford University for sending me a copy of the *Stanford Ichthyological Bulletin* containing the article referred to above, and to Dr. S. L. Hora, Director of Fisheries, Bengal, for going through this note and communicating it for publication.

Central Research Institute,
University of Travancore,
Trivandrum,
December 11, 1943.
S. JONES.

1. Myers, George S., *Stan. Ichth. Bull.*, II, 1942, 4. 2. Jones, S., *Proc. Ind. Acad. Sci. (B)*, 1937, **56**. 3. Job, T. J., *Rec. Ind. Mus.*, 1940, **42**, 1. 4. Kulkarni, C. V., *Ibid.*, 1940, **42**, 2. 5. Tennent, J. E., *The Natural History of Ceylon*, 1861. 6. Thomas H. S., *Report on Pisciculture in South Kanara*, 1870. 7. Day, F., *Report on the Fresh-water Fish and Fisheries of India and Burma*, 1873.

ON THE BIONOMICS OF BIG-JAWED JUMPER, *LACT LACTARIUS* (Cuv. & Val

THE Big-jawed Jumper, *Lactari* (Cuv. and Val.) is a shoaling fish to an important fishery in the Gulf and Palk Bay, from the month of month of January. The peak of occurs in September and October.

Food.—The Big-jawed Jumper is rcus fish, feeding on other smaller s as the Sprat (*Sardinella gibbosa*), th (*Engraulis indicus*), the White-ba *phorus sp.*), the Jew-fish (*Sciœna* Silver-bellies (*Leiognathus sp.*), you fish (*Trichiurus savala*), the Sole *rhombus arsius*), the Shrimp (*Ace cus*) and the Prawn (*Peneus sp.*). the White-bait appears to be its fav

Size.—Over three thousand specim ing in size from 11 to 25 cm., were in the laboratory of Krusadai Biol tion during the years 1940-41, 19 1942-43. The commercial catches co ly of specimens 17 to 21 cm. in le percentage of males in a shoal is al than that of the females, in some cas as low as 25. The males are small ing within 18 cm.; and they becor when they are 16 cm. in length, w females are larger, attaining a 25 cm. and they become mature whe 18 cm. in length.

Spawning season.—The spawning confined to the months of September ber, when the fishery is at its heigh females form the bulk of the catches; yet their heavy destructio seem to diminish or deplete the fish

Eggs.—The ripe ovarian egg mea to 0·76 mm. in diameter, with a si yellowish oil-globule measuring 0· diameter.. Attempts made to collec eggs from the sea off Thangachimada ing village four miles east of Pamb the fishery takes place, have not success. It is probable that the ripe the open sea beyond the three-mile the catamarans, to spawn there unr

Fisheries Bureau,
Madras,
February 24, 1944.
P.

* Published with the permission of the Industries and Commerce, Madras.

SIR JEREMY RAISMAN'S BUDGET SPEECH

WE wish to invite the attention of our readers to the relevant portions of the enlightened budget speech of Sir Jeremy Raisman, the Finance Member to the Government of India (appearing elsewhere in this issue), relating to the capital and recurring grants for the establishment of National Research La This generous gesture, which is "a expression of the Government's r foster the development of Indian in is hoped, will soon be followed by stantial grants.

REVIEWS

Optical Workshop Principles. By Col. Dévé Translated by T. L. Tippell. (Adam Hilger Ltd.), 1943. Pp. 306 + xiv. 20*s*.

Le Travail Des Verres D' Optique De Precision by Col. Dévé was originally published in Paris in 1936. The book under review is an English translation brought out last year by Adam Hilger Ltd. It is in two parts, the first dealing with the elementary aspects and the second dealing with the more difficult and precise operations of optical technology. Under the elementary aspects, the properties of glasses, their faults and the principles that should guide one in choosing raw material are dealt with. There is a very useful account of different kinds of abrasives and cements. Hints which are of great practical value are given as to their utility under different conditions. In the same part, methods of surfacing are also dealt with. In the second part, definitely intended for those interested in work of high precision, the subject of surfacing is dealt with in greater detail and the use of test plates of different types is described. The processes of cutting, grinding and polishing varieties of crystals are described. Various other processes such as centring, edging, cementing, etching, silvering, etc., a knowledge of which is essential for a person working in Applied Optics are also dealt with.

The book contains a large amount of interesting and valuable information. It is eminently practical in its outlook and is accordingly indispensable to people engaged in optical work. The technique of producing either flat or curved surface to a state of perfection demanded by modern requirements is a highly specialised one and there are very few books in the English language which deal with this aspect of optics. The present publication is very welcome from this point of view.

S. B.

Experiment and Theory in Physics. By Max Born. (Cambridge University Press), 1943. Pp. 44. 2*sh*.

This pamphlet contains the substance of an address given by the author to the Durham Philosophical Society and the Pure Science Society in King's College at Newcastle-upon-Tyne. Basing himself on the details of some outstanding events in the development of modern physics, the author discusses the methods employed by the two extreme schools of investigators comprising on the one hand of men who declare experiment to be the only genuine method of science and on the other of men who claim that all universal laws of nature could be derived from pure epistemological principles and without any appeal to experiment. According to the author the history of modern physics shows that theoretical conceptions and experimental discoveries were alternatively taking the front place as time went on and we owe the present position neither to pure reason alone nor to pure experiment alone but to a process of mutual interaction giving rise to a long chain of empirical research and synthesis. The author concludes by stating that scientific prophecy is better based on the facts of experience than on abstract reasoning. The pamphlet forms an interesting reading.

S. B.

An Introduction to the Modern Theory of Valency. By Dr. J. C. Speakman. Second Edition. (Edward Arnold and Co., London), 1943. Pp. 159. Price 5*sh*. 6*d*.

This book amply justifies its claim to be an introduction to the modern theory of valency. It is written in an easy flowing and convincing style, and takes the reader right from the basic principles of electrovalency and covalency described in the first five chapters, to a lucid and non-mathematical survey of the essential features of modern valency theory based on the methods of quantum and wave mechanics. Chapter VI deals briefly with the mechanism of covalency bond formation through coupling by the exchange resonance of valency electrons belonging to different nuclei. This concept of electrons in resonance, leads to the possibility of different electronic arrangements for the same molecule being coupled to each other by exchange resonance, forming thereby a "resonance hybrid" of greater stability. Chapter VII describes some of the important quantitative studies on valency bonds. In the reviewer's opinion, an adequate reference to the vibration frequencies for these bonds as evaluated by the very elegant method of Raman spectra would make the picture more complete. Chapter VIII describes very clearly the concept of intermolecular linking by 'hydrogen bonding, and also makes an adequate reference to other types of intermolecular coupling through ion dipole, dipole-dipole, and Van der Waals or "dispersion forces". The succeeding chapters deal with polar and non-polar compounds, relationship between electrovalency and covalency, and the varying valencies exhibited by the elements in the long periods. Chapter XII on Co-ordination and Hydration gives a clear account of Werner's Co-ordination Theory. In Chapter XIII are considered the stereochemical aspects of valency, and it is shown how the wavemechanical treatment of valency angles has justified the pure chemist's sound instincts, as witness the phenomenon of d^2sp^3-hybridisation leading to Werners's hypothesis regarding the stereochemistry of hexavalent complexes. The last chapter, XIV, is a short discussion of the electronic theory of acids and bases.

This little book of only 159 pages is neatly printed and got up, and except for an obvious error in the structural formula for the sodium derivative of benzoyl acetone on page 135, is free from mistakes. It is moderately priced and should provide a very good supplementary

reading to undergraduates as well as to others who desire to become acquainted with the recent advances in this field.

M. A. G.

The Rayon Industry, Possibilities of its Establishment in India. (All-India Manufacturers' Organisation Monograph No. 4, Bombay), 1944. Pp. 25.

This pamphlet advocates the early establishment of a factory for the production of Artificial Silk by the viscose process, in India. The statistics given show that this country imports or was importing in 1937–39, 50,000,000 lbs. of rayon per year, a considerable portion of which, in the form of rayon and staple fibre, was used up by our great textile industries. This dependence of a key industry for an important product on foreign supplies, is to say the least, not healthy. The pamphlet indicates very briefly the prospects for the establishment of such a factory in terms of availability of raw materials, such as wood and bamboo pulp, cotton linters, and short-staple cotton, plant location, chemicals required, technology of production, labour and management, daily capacity (10 tons), investment required (one crore rupees) and profits (a safe minimum of 20 per cent.).

M. A. G.

Soil and Plant Analysis. By C. S. Piper. (The University of Adelaide, South Australia), 1942. Pp. x + 368, Illustrated. Price 15s.

This book is a monograph from the Waite Agricultural Research Institute. It brings together in one volume, the more important and the more widely used analytical methods for soils and plants.

About the beginning of the present century H. W. Wiley published his *Principles and Methods of Agricultural Analysis* in three volumes. Later Klein in his four volumes of *Pflanzenanalyse* has brought together and dealt with in considerable detail the methods and techniques scattered over a large number and variety of periodical publications. The Association of official Agricultural Chemists in U.S.A. has been rendering yeoman service to their fellow-workers in America and elsewhere by publishing a journal and by issuing from time to time revised editions of their well-known publication *Official and Tentative Methods* which is in use in the laboratory of every agricultural chemist.

With the development of soil and plant research in geographical extension, the need has been felt to modify methods of analysis to suit special requirements of particular localities, materials and laboratories. To this end workers in India, Australia and Africa published from time to time several modifications of well-known methods. As far back as 1928 Dr. J. A. Prescott of the Waite Agricultural Research Institute published a bulletin in the series of publications, issued by the Commonwealth Council of Scientific and Industrial Research, Australia, dealing with soils. Dr. Piper who has been long associated with Dr. Prescott has, in the publication under review, reproduced the methods of soil analysis previously described in the aforesaid bulletin and has also added a good deal of other selected data in the first part. In the second part he has furnished *valuable* information in regard to the inorganic constituents of plants and their methods of determination.

Information on the subject of trace or minor elements and their bearing on soil and plant nutrition is widely scattered among a number of publications. Dr. Piper has collected the relevant information and presented it in a readily accessable form. Dr. Piper has not included (and in the reviewers' opinion rightly) a chapter on rapid methods of analysis and on foliar and other diagnostics of plant and soil deficiencies, presumably because their usefulness in soil fertility investigations is not yet established for inclusion in a book of the kind meant as a laboratory companion for agricultural workers.

The book is attractively got up and is free from mistakes. It should prove a useful addition to the library of an agricultural chemist.

B. V. N.

STARCH AND ITS DERIVATIVES*

THE second edition of the monograph on starch will be warmly welcomed, if only because the revision has vastly improved the intrinsic value of a work of acknowledged merit. Owing to the dislocation of normal trade channels due to the present emergency, the requirements of essential industrial product, have to be met by stimulating indigenous production. This is particularly true in India with a gigantic textile industry consuming large quantities of starch and a series of its derivatives. The position is particularly critical as the accepted sources of starch, *viz.*, cereals and tubers, constitute valuable items of food which have to be conserved for human consumption. The position demands careful and informed consideration at the hands of technologists. The appearance of a monograph summarizing the latest developments in an important branch of chemical industry and presenting a very balanced account of the scientific and technological researches should be considered very opportune.

The beginnings of the starch industry date back to the earliest periods of recorded history. The discovery of dextrin, reminiscent of Lamb's account of the roast pig, extended the field of industrial application of starch. The more recent studies on the derivatives of starch, notably on the ethers and esters, have opened up new industrial possibilities. On the vexed question of the structure of starch itself, the

* "Starch and Its Derivatives", by J. A. Radley (Chapman & Hall Ltd., London.) Second Edition (revised). 1943. Pages xii + 558; Price 38 .

recent work of Hanes (1940) has provided a decisive answer and a rigorous explanation of a vast array of observations by numerous investigators is now possible. The story of starch, comprising the historical, scientific and technological aspects, has been told in this monograph in great detail and with amazing accuracy. The monograph provides valuable information and serves as a stimulus to research workers engaged in the study of the chemistry of starch and industrial applications.

To comprehend the scope of the technology of starch, it is necessary to mention that straight and modified starches and starch derivatives, find application not only in several major industries, such as textile, paper, laundry, fermentation and food industries, but also the demands of each industry are very varied and exacting. A few instances may be cited to serve as illustrations. For the surface sizing of paper, fluid pastes are required but for securing stiffness and for formation of the multilayers a viscous adhesive is demanded; the confectionary industry demands what is called "clear gum" which will not become opaque on ageing; adhesives for stamps, envelope flaps and labels, which come into contact with the tongue, should be tasteless and odourless; pastes for cigarette papers should emit no smell, nor impart any taste when "smoked", nor should the paper pucker when the paste is applied; adhesives for labelling tins should wet and penetrate the grease with which the tin surface is smeared in order to be effective; laundry stiffening mixture should be such that when ironed or calendered the fabric should take a high gloss; in coating labels, the pastes should be smooth so as to facilitate application by machinery on a mass production scale. These and numerous other requirements, exacting as they are, have been met through careful laboratory investigations. The theoretical principles which form the basis of the applications, have been adequately explained in the monograph and this constitutes, perhaps, its most conspicuous feature.

A study of the various chapters comprising the book, reveals that notwithstanding the large amount of work carried out, there are important gaps in our knowledge of the chemistry and technology of starches. The book poses several problems for solution and the discerning reader will find enough material on which he can exercise his thought and make new discoveries of profound significance. In considering such possibilities, he will obtain ample guidance and inspiration from the spectacular developments in the field of cellulose chemistry. The fundamental difference between starch and cellulose lies in the circumstance that the glucopyranose residues in the former are united by 1:4-α linkages, while in the latter the union is through 1:4-β linkages. This difference manifests itself in the granular and fibrous structures of starch and cellulose respectively. Both starch and cellulose yield analogous derivatives, *e.g.*, nitro-derivatives, acetates, ethers, esters and xanthogenates, with differences in properties attributable to differences in structure. Nitro-starches can be employed as explosives. Acetates find use in the production of transparent elastic films. Benzoylated starches can be suitably processed to yield glossy, resinous products soluble in acetone, alcohol and aromatic hydrocarbons. Despite the developments already made, the possibilities of the derivatives of starch remain yet unexplored.

The descriptions of the methods of manufacture of root and cereal starches are critical and informative. Photographs of the machinery employed are provided and the different stages of manufacture are indicated by flow diagrams. Those who are interested in the development of the starch industry in India will find in Part 2 of the monograph ample material of immediate value. The organization of the starch industry on rational lines is an urgent necessity in India, particularly in view of the existence of a big internal market. The production of raw materials, their processing and the manufacture of starches and their derivatives demand planned development.

The author has secured the co-operation of a number of experts—Prof. E. L. Hirst, Dr. G. T. Young, Mr. G. V. Caesar, and Prof. F. F. Farby—in the compilation of the book. He is entitled to the gratitude of a large number of readers for the critical appraisal and a masterly exposition of the latest developments in an important field of chemical industry.

B. N. Sastri.

SCIENCE NOTES AND NEWS

Portraiture in Ancient Egypt.—Dows Dunham, in an illustrated article in the *Bulletin of the Museum of Fine Arts*, Boston, XLI, No. 246, December 1943, discusses whether some of the well-known Egyptian sculptures of the Fourth Dynasty cannot be regarded as portraits in the modern sense. Modern portraiture at its best seeks to represent by lines or colour, the physical and spiritual features of the subject, as interpreted by the artist. It is difficult for us in the twentieth century to visualize men of the 27th century B.C. as living personalities. A portrait to ancient Egyptians served ritual, but not artistic, ends, and the result was that, except in special cases, the sculptures were stylised and stereotyped. But occasionally, when the man for whose spirit's shelter the effigy was fashioned happened to be of high status, the artist's work became portraiture revealing personality and individual characteristics. Eight sculptures from Giza in the Museum of Fine Arts at Boston are discussed in the paper, *viz.*, (1) the head of an unknown prince sculptured with exquisite skill in white

limestone; (2) a princess with Negroid features; (3) a high official, "Overseer of the two Houses of Silver"; (4) the same in relief; (5) bust of Ankh-haef, the vizier; (6-8) figures of King Mycernius as a youth, as a mature person, and with his queen. According to the author, "the bust of Ankh-haef' is the supreme example of realistic portraiture which has survived from ancient Egypt, alike for its freedom from convention and for its freedom of execution". This figure is also as usual in white limestone, covered over with plaster of Paris in which, while still wet, finer details have been worked and later painted brick-red all over including the head. A. AIYAPPAN.

A rich prehistoric microlithic and bone industry, besides remains of several partly fossilized mammalian bones and three incomplete human skeletons, have been discovered in Gujarat by the Second Gujarat Prehistoric Expedition organised by the Director-General of Archæology in India.

The discovery of so many human and animal remains and a bone industry comprising tools and articles of decoration, such as beads, in association with microliths, is the first of its kind in India. It may lead to results of the greatest importance for the study of early man in India.

The expedition worked with the co-operation of the Director, Deccan College Post-Graduate and Research Institute, Poona, and the staff of the History Department. It has been conducting excavations at Langhnaj, Mehsana Prant, Baroda State (Gujarat).

In the course of his budget speech to the Central Legislative Assembly (29th February 1944), the Hon'ble Sir Jeremy Raisman said:—

"In connection with industrial research we have made provision for a grant of Rs. 10 lakhs for the construction and equipment of glass and fuel research laboratories and for general planning for other institutions. *The Council of Scientific and Industrial Research* has done valuable work within the limits of the funds allotted to it by Government, and the Government of India have now agreed to the *Council* drawing up plans for co-ordinated scheme for the advancement of research on the assumption that Rs. 1 crore will be forthcoming towards capital expenditure on a chain of research institutions. The institutions in contemplation, in addition to the two I have mentioned, are a National Physical Laboratory, a National Chemical Laboratory and a National Metallurgical Laboratory. The balance of Rs. 1 crore will be spread over a period of three or four years after the cessation of hostilities. This step will, I am sure, be regarded as a practical expression of Government's resolve to foster the development of Indian industry and should, at the same time, serve as an incentive to private enterprise to come forward and support industrial research. A handsome beginning has already been made by the Tata Trust, whose enlightened liberality in matters of this kind I gladly take this opportunity to acknowledge; they have now increased their promised donation of Rs. 8·30 lakhs towards a National Chemical Laboratory by a further Rs. 11·70 lakhs towards the proposed National Metallurgical Laboratory, making Rs. 20 lakhs in all."

Addressing the Convocation of the Calcutta University on the 4th March 1944, Sir S. Radhakrishnan, Vice-Chancellor of the Benares Hindu University, pleaded for priority for education among the schemes now being considered. He said, "The war has exposed the weakness of our Government, our economic life and our system of education. The death due to famine conditions of a million people, even if we accept the figures given by the Secretary of State for India in the Commons, is not essentially different from or less costly than the death of a million people in any other part of the world. If we realise what this means in terms of human suffering and sorrow, we should be filled with shame and resentment, and a burning desire to wipe out the conditions which make such things possible.

"A well-planned and vigorous economic expansion, involving the introduction of modern technical and industrial methods of producing goods and services, an all-out development of education and public health alone can give relief to a long-suffering people and restore national vitality. ... Social security, communications, health and sanitation, were all important but education which was concerned with the making of man was the most important. The Sargent Scheme gave a comprehensive plan of education for all stages from childhood to maturity and attempted to make the educational system organic to the community. It was a long-term national enterprise and its full realisation would take at least a generation and demand the sustained efforts of the community and the effective co-operation between the Government and the other agencies. If India was not to lag behind other progressive countries, the scheme should be put through."

In the course of his presidential address to the Academy of Indian Medicine, Captain G. Srinivasa Moorthy emphasized the need to provide for the study of Indian medicine in any scheme of medical education that might be planned for India. A unified scheme of medical studies was urgently needed, and it was desirable that every allopathic practitioner seeking to practise in India, should be required to have a working knowledge of Indian medicine to which about 90 per cent. of the population resorted for relief. The Madras Government had already instituted post-graduate courses in Indian Medicine lasting two years and open to qualified practitioners of allopathy. A study of Indian medicine should also be included in the curriculum of studies of allopathic institutions.

An Indian Scientific Mission led by Sir S. S. Bhatnagar will shortly leave for England under the ægis of the Central Government to study the working of scientific research organisations there in relation to the war effort. The delegation includes Sir J. C. Ghosh, Prof. M. N. Saha, Sir P. M. Kareghat, Dewan Bahadur

Dr. A. L. Mudaliar, Col. S. L. Bhatia and Prof. S. K. Mitra.

A scheme to train promising young Indians in the United Kingdom for technical posts of Officers' status is now under consideration of the Government of India.

On the basis of returns from factories, the Director of Imperial Institute of Sugar Technology estimates the production of sugar from cane at 1,205,300 tons as against an actual output of 1,070,700 tons in 1942-43 season.

In connection with post-war planning, Mr. J. S. Bolton, Financial Secretary to the Government of Sind, has been appointed Financial Adviser to the Government of India, Post-War Development Department. Mr. Sen Gupta, Financial Adviser to the Communications Department, has been deputed to plan post-war schemes for the Post and Telegraphs Department and he is expected to submit his report by the end of May. Sir Feroz Khareghat, Vice-Chairman of the Imperial Council of Agricultural Research, has been entrusted with the task of preparing a memorandum on the general lines which post-war agricultural planning should follow.

The Raja of Munagala has donated Rs. 17,500 to the Andhra University to institute the "Raja of Munagal's Emperor Krishna Deva Raya Research Fellowship" to promote research into South Indian Archæology, History and Culture with special reference to Andhras and including Andhra Colonies in the Pacific and the Far East.

The Council of Scientific and Industrial Research has agreed to Sir S. S. Bhatnagar's proposal to split the Laboratories of the Board of Scientific and Industrial Research into two sections—a chemical laboratory and a physical laboratory—with a view to facilitate their amalgamation respectively with the National Chemical and the National Physical Laboratories, the plans of which have already been drawn up. Dr. S. Siddiqui will be placed in charge of the chemical section while Dr. Lal C. Verman will be responsible for directing the work of the physical section.

The Council of Scientific and Industrial Research has accepted the suggestion made by Prof. M. N. Saha and Dr. C. W. B. Normand, to institute an Atmospheric Research Committee.

The Government of Madras have sanctioned the extension of the Agricultural Research Station at Pattambi (Malabar) at a cost of Rs. 1,47,100. About seventy acres of land adjacent to the Farm have been acquired. The Station will increase the supply of improved strains of paddy.

The Government of Madras have approved a non-recurring initial expenditure of Rs. 75,000 for the construction of buildings, static tanks, etc., and for the purchase of instruments and equipment, in connection with the formation of an Irrigation Research Station at Poondi.

The Secretary, Vincent Massey Scholarship Selection Committee, 5, Russel Street, Calcutta, announces that applications for the scholarship should reach him not later than June 1, 1944. The scholarship tenable for a year at the University of Toronto for post-graduate work, will be awarded by H. E. the Viceroy, on the recommendation of the Selection Committee.

Mr. M. Rahimullah Quraishi of the Osmania University has been awarded the degree of D.Sc. of the Madras University on the thesis entitled "A Comparative Study of the Morphology, Histology and Probable Functions of the Pyloric Cæca in Indian Fishes, together with a Discussion on their Homology". This thesis was supplemented by a dozen other original papers on similar problems.

The Government of India have sanctioned a scheme for the Imperial Dairy Department by which the Imperial Dairy Research Institute at Bangalore will be taking two honorary research workers from July 1944 for carrying out advanced research work for a period of one year. The problems for research will be confined to those bearing on the Chemistry and Bacteriology of milk and milk products, Technology of milk processing and manufacture of milk products and Cattle Husbandry coming within the purview of the present activities of the Institute. The workers will be exempt from payment of any fees but subject to the other conditions and rules of discipline prescribed at the Institute. They will also have to make their own arrangements for boarding and lodging. The candidates will have the facilities for doing post-graduate work for the M.Sc. and Ph.D. degrees of the Bombay University and other Universities by whom the Institute has been recognised as a suitable centre for the purpose. Intending candidates, who are graduates of Indian or European Universities, and preferably with First Class M.Sc. or B.Sc. Honours qualification may apply to the Director of Dairy Research, Bangalore, at an early date giving full particulars of their age, qualifications, research experience, nature of problem desired to be studied, etc., etc.

The National Chemical Laboratory.—A scheme for the establishment of a National Chemical Laboratory for India after the war has been drawn up by a committee of the Council of Scientific and Industrial Research. The Laboratory is intended to specialise in industrial research and develop new processes up to the pilot plant stage.

"The proposed National Chemical Laboratory in India is expected to follow, more or less, the lines which have been accepted for the chemical research laboratories in Teddington (London), although the technical nature of our problems may be somewhat different owing to our special needs.

"It has to be borne in mind that while fundamental problems in various branches of chemistry will be promoted and encouraged as no new industrial work of any importance is possible without the researchers being engaged in increasing the bounds of fundamental knowledge, greater emphasis will be laid in this Laboratory on industrial research and the development of new processes up to the pilot plant stage, so that the chemical industry and other industries requiring the aid of chemical research in general will benefit from the investigations carried out in this Laboratory.

"In India such facilities for research work up to the pilot plant stage are rarely available and such scientific research as had been carried out so far has not been so convincing to industrialists and the would-be manufacturers as it might have been if the success of a process had been demonstrated on a large scale.

"This aspect of the question will distinguish the National Chemical Laboratory from the rest of the laboratories either in the universities or in any technical institution run privately, or under semi-Government control. It will maintain the closest co-operation with existing institutions, particularly as the National Laboratory will be able to initiate those ambitious investigations which are not carried out in university laboratories either for want of funds or for the reason that the problems have a predominantly industrial bias."

It is proposed that the Laboratory should, at present, provide accommodation and facilities for the following main branches of chemistry: Inorganic Chemistry, including analytical investigations; Organic Chemistry, including drugs and chemo-therapy; Physical Chemistry, including high-pressure technique and electro-chemistry; Bio-Chemistry, including biological products and chemical engineering.

With a proper co-ordination of the activities of these sections, it will be possible, the report states, to deal with new raw materials and problems relating to a number of industries, such as heavy chemicals (acids, alkali, salts, etc.); minerals, particularly from the analytical standpoint, and such industries as the non-metal industries: fertilisers, organic and inorganic chemicals, including solvents, pharmaceuticals and food; fermentation and biological products; resins and plastics; paints, pigments, lacquers and varnishes; oils, fats, soaps and lubricants; essential oils, rubber, petroleum, high-pressure research and electro-chemical industries.

The workshops and pilot plant equipment suggested for the Laboratory ought to enable the Laboratory to undertake, ordinarily, any type of industrial research.

Public opinion on the tentative scheme is invited. Scientists and scientific bodies and commercial men and commercial bodies interested in the proposals will be supplied with copies of the scheme, on request, by the Director of Scientific and Industrial Research, University Buildings, Delhi.

MAGNETIC NOTES

Magnetic conditions during March 1944 were more disturbed than in the previous month. There were 10 *quiet* days, 20 days of *slight* disturbance and 1 day of *moderate* disturbance as against 8 quiet days, 20 days of slight disturbance and 3 days of moderate disturbance during the same month last year.

The quietest day during March 1944 was the 17th and the day of the largest disturbance the 4th.

The individual days during the month were classified as shown below.

Quiet days	Disturbed days	
	Slight	Moderate
2, 3, 5, 15–17, 20, 21, 23, 24.	1, 6–14, 18, 19, 22, 25–31.	1

No magnetic storm occurred during the month of March 1944 while one moderate storm was recorded in March last year.

The mean character figure for March 1944 was 0·71 as against 0·84 for March 1943.

A. S. Chaubal.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 92, Nos. 4655-56.

"Journal of Agricultural Research," Vol. 67, Nos. 7-8.

"Journal of Chemical Physics," Vol. 11, No. 11.

"Experiment Station Record," Vol. 89, No. 6.

"Indian Farming," Vol. 4, No. 9.

"Transactions of the Faraday Society," Vol. 39, Pt. 12.

"Indian Forester," Vol. 70, Nos. 2-3.

"Indian Central Jute Committee Bulletin," Vol. 6, No. 11.

"Indian Medical Gazette," Vol. 79, No. 2.

"The Review of Applied Mycology," Vol. 22, No. 12.

"American Meteorological Society Bulletin," Vol. 24, Nos. 7-8.

"Nature," Vol. 152, Nos. 3870-71.

"American Museum of Natural History," Vol. 52, Nos. 4-5.

"Science and Culture," Vol. 9, No. 9.

Books

Climate and Labour. By W. Burridge. (Kitabistan, Allahabad), 1944. Pp. 167. Price Rs. 5-4-0.

Pollen Analisis. By G. Erdtman. (Chronica Bctanica, Waltham, Mass., U.S.A.; Calcutta: Messrs. Macmillan Co.), 1943. Pp. 289. Price 5 dollars.

Soviet Russia, the Secret of Her Success. Edited by K. S. Hirlekar. Avanthi Prakashan, Bombay), 1944. Pp. 391. Price Rs. 6-8-0.

371-44—The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

CURRENT SCIENCE

Vol. XIII] MAY 1944 [No. 5

FUTURE CITIZENS

COMPULSORY education for a population of thirty crores is the gigantic enterprise framed by the Sargent Scheme, short name of the plan for post-war Indian educational development laid by the Central Advisory Board of Education, whose report thereon was released last March. It will not be an exaggeration to say that if this plan can be made operative, the result will be a New India, fitted to assume the burden of world responsibility to which she is entitled by history, numbers, natural resources and the genius of her people. The difficulties of accomplishment are great, and the effort demanded by their solution enormous: but they must be surmounted if India is to take her proper place among cultivated and progressive nations.

A bare outline of the plan will facilitate its consideration. Pre-primary, conveniently called nursery education, will begin at age 3 and remain voluntary until 6, at which the compulsory system begins with junior basic (primary) school until age 11 followed by senior basic (middle) school until 14. Dovetailed with basic will be the high school whose course should cover 6 years, normally beginning at age 11 for only those pupils who show promise of benefiting fully by the opportunities provided; and preparation being made for at least one child in every five of the appropriate age-group. There follows the university, conditions of admission to which will be adapted to ensuring entrants' capability of profiting by the classes. It is contemplated that ultimately the intermediate course will be merged in high school, when the minimum degree course will be 3 years; meanwhile, only the first year will be transferred to high school, the second year being taken at the university. Finally, provision is made for technical, commercial and art education, for adult education and for training of teachers.

This last item is the most important, numerically and vocationally. The proposed national system outlined above will require 20 lakhs of teaching non-graduates for schools of all types with 1,80,000 graduates for teaching the high schools; and as existing institutions are barely sufficient for repairing wastage, and training new teachers for the present system, abundant new training schools and colleges will be needed. It is intended that suitable boys and girls be selected as the close of high schooling approaches, and that the training be free, with liberal assistance for the maintenance of poorer scholars. It cannot be too strongly emphasised that the determining factor in any system of education is the teacher, and no trouble must be spared in recruiting young men and women with vocational urge to spread knowledge and build character among their junior compatriots.

Such young people having been discovered and trained they must be properly paid. The current remuneration of teachers is disgraceful, and is explicable only on the assumption that authorities responsible do not regard education as a service of any real public importance. The average pay of primary teachers in government schools is Rs. 27 per mensem, and in private schools is generally lower, one large province averaging Rs. 10. The Board has naturally found some difficulty in assessing appropriate new scales owing to the artificial rise in living cost: but whatever the final amounts may be, they must be sufficient to range the teacher in a social stratum commensurate with the high responsibility of his task. No nation has yet had the courage to be logical in the order of payment, and award the largest salaries to the elementary teachers because their influence on the pupils for good or evil is the greatest; and it would perhaps be unreasonable to expect the Board to have taken this plunge.

From the foregoing it follows that the age-limits of compulsion will be 6 and 14. This period of education without any charge to the

parents is considered sufficient to equip the pupils for citizenship provided the training of character proceeds conjointly with training of intellect at every stage. There is great scope for improvement in both fields. An overall illiteracy of 85 per cent. is a ragged garment for democracy, and would bode ill for this country if that form of government is finally adopted. Citizenship has been usefully defined as an activity of the personality to secure certain benefits for the community to which the citizen belongs, and its proper exercise involves such qualities of character as consideration for others, commonsense and self-discipline. That these are sadly lacking is apparent in many little ways, notably the misuse of roads, where animals wander and children play while bicycles dart here and there regardless of rules; and controllers of the slowest traffic have no compunction in occupying the middle. It is noteworthy that in Travancore, with an overall 45 percentage of literacy (56 for men; 34 for women), these abuses are not observable.

The Board urges encouragement of games and physical exercise, wisely too, because games promote self-discipline and consideration for others by developing corporate action. People accustomed to playing games and watching others play them do not require to be queued at the entrance and the railway ticket office: they queue themselves instinctively, thereby saving each other limitless exasperation and inequitable treatment. They gradually learn that the disabilities under which we writhe, and which we sometimes rather monotonously bemoan, may be less owing to dominant institutions and forms of government than to our own deficiencies of intellect or temperament. Even in such game-loving countries as England and the United States, however, consideration for others remains elusive, as witnessed by the 1937 coronation bus-strike in England, and the pre-invasion coal-strikes in both countries, heartless tyrannies of organised labour endangering those liberties—including their own —for which the cream of humanity is being sacrificed. It follows that even among nations practising compulsory education, this is ineffectual to promote citizenship unless accompanied by change of heart.

These remarks draw sharp distinction between education and instruction. The young gentlemen of respectable appearance who hold committee meetings leaning against their bicycles in the middle of the road may have been instructed and perhaps have taken a university degree; but they have not been educated. The busmen have been instructed in motor mechanics, and the miners in coal-getting; but they have not been educated. It may not be amiss here to mention a useful factor in self-education, the pursuit of a hobby. However primitive in operation, wood-carving, flower-pressing, silkworm-tending, stamp-collecting and butterfly or moth-catching, all accompanied by essay-writing to describe results, are not merely interesting relaxations, but may become the means of revealing some latent bent or skill, and thus lead to that most enviable of goals, namely, intrinsic enjoyment of the occupation by which you earn a living. Moreover, they promote habits of systematic arrangement, attention to detail, and tidiness which may be trusted to bear useful fruit in the ordinary commerce of daily life.

Equally with the new British Education Bill made public on 16th December 1943, the Board recommends basing the children's early training on religious principles, always in conformity with parents' own beliefs. Child psychology needs the idea of a super-parental authority, but there should be a minimum of complicated ritual or theology. In fact, if only the world had accepted and implemented the simple injunction "Do unto others as you would they should do unto you", history would have remained innocent of those wars and revolutions that have blackened its pages during 1,900 years.

If the Sargent Scheme were to accomplish nothing beyond inculcation of citizenship, *i.e.*, consideration for others, commonsense and self-discipline, it will offer a handsome return for the huge ultimate annual cost around 300 crores of rupees. It is reasonable to expect, however, that the process of selection involved in its application to Indian youth will reveal hidden talent and latent genius now lost in the morass of general ignorance. The Board's proposals for technical, commercial and art education should then yield a rich harvest, having been meanwhile tested with existing material. In this connection it is curious to note that the Board seems oblivious to the existence of the Indian Institute of Science, Bangalore, perhaps because only one of the forty-one distinguished Board Members has been actively associated with it. This is typical of government compartmentality. Referring to the sandwich system the Board advises (p. 42) that "the adoption of such a system would be of particular value to India", evidently unaware of its having flourished in this country during thirty years past. It was introduced by the late Dr. Alfred Hay and continued by Prof. J. K. Catterson-Smith, to the lasting benefit of students in the department of Electrical Technology, Indian Institute of Science; from which, for instance, over 90 per cent. of the technical radio-personnel of Indian broadcasting have sprung. It would not diminish the authority of the Board if the Director of the Institute, *ex-officio*, were admitted to membership.

From another standpoint also this is desirable. One of the late Sir Dorabji Tata's aims in founding the Institute was to secure the training of post-graduates in methods of research; but the only practical reference by the Board to this activity is to mention (p. 35) "the importance of establishing a high standard of post-graduate studies and particularly in pure and applied research". The sentence effects a condensation positively Kiplingesque, and casual readers of the report cannot be expected to grasp its implication: which is, that unless a citizen has acquired by training, or is otherwise happily endowed with a research attitude of mind he is at the mercy of any smooth-tongued personage, commercial or political, who may regard him as legitimate prey.

The practice of weighing evidence, balancing opinions and mistrusting slogans is urgently needed in this country, particularly among the young, whose generous enthusiasms tend to misdirect their activities unless controlled by the research spirit. If democracy becomes the final form of Indian government it will surely founder unless the habit of inquiry becomes more widely diffused; and probably this aspect of research is even more important to India than its potentialities as a dividend-payer.

Among the most interesting chapters of the report is that on adult education, which it is proposed to launch in the sixth year of the programme, thus allowing for initial planning and for assemblage of competent teachers: itself a problem evidently viewed with some apprehension by the Board because they consider tact, understanding and ability to be required in higher degree for teaching adults than for teaching children. This is the old heresy on which the underpayment of elementary teachers is based, and the Board must be calculating on a hitherto unsuspected missionary zeal among the prospective instructors if remuneration is to be only Re. 1 per hour for a class of 25 illiterates. When the existing 9 crores of illiterates have been liquidated by these exertions, adult education proper will become the principal activity of this department, supported by visual and mechanical aids such as the cinema, gramophone and radio. "Dancing, particularly folk-dancing, music both vocal and instrumental, and drama will also be useful, but not only as pleasant accomplishments in themselves as well as recreative activities, but also as helping to attract and stimulate adult students." This may sound frolicsome to many, who will doubt whether these delights can be achieved by those adults who do not already possess a strong urge to self-education.

Returning for a moment to fundamentals, it may be worth while to recall some words of J. A. Froude: "I accept without qualification the first principle of our forefathers, that every boy born into the world should be put in the way of maintaining himself in honest independence. No education which does not make this its first aim is worth anything at all. A tree must be rooted in the soil before it can bear flowers and fruit. A man must learn to stand upright upon his own feet, to respect himself, to be independent of charity or accident. It is on this basis only that any superstructure of intellectual cultivation worth having can possibly be built."

Concluding chapters of the report deal with training of teachers, health of the school child, education of the handicapped, recreative activities, and employment bureaux. Recommendations on these and the foregoing sections are based on the reports of eight committees appointed since 1935. The conclusions now published represent an earnest, informed and enlightened attempt to provide a workable plan for the future education of Indian youth, and the Board merit the gratitude of all right-minded citizens for their labours. The Hon'ble Sardar Sir Jogendra Singh (*Chairman*), Mr. John Sargent (*Educational Adviser to the Government of India*) and their 39 colleagues are to be congratulated on having produced a deeply interesting report and the framework of a beneficent educational revolution. Thomas Jefferson, who wrote (1776) the declaration of American Independence, also wrote (1786): "I think by far the most important bill in the whole code is that for the diffusion of knowledge among the people. No other sure foundation can be devised for the preservation of freedom and happiness." Lovers of this country, whether Indian or British, will devoutly hope that these brave words may find fulfilment in the Sargent Scheme.

M. O. F.

SIR CLARENCE A. BIRD, K.C.I.E., C.B., D.S.O.

Master-General of Ordnance in India, and Chairman of the Supply Development Committee, GHQ (India)

THE retirement of Sir Clarence Bird will be deeply regretted in this country. He is a great patron of science and scientific men. During his regime, the scientific organizations in the Ordnance Branch expanded enormously. Science was called in more and more to aid the war effort. The assistance of scientific and technological institutions in the country was sought to deal with a variety of problems ranging from the manufacture of fine chemicals to development or modification of stores and equipment, their production and storage under tropical conditions, etc.

In 1942, Sir Clarence sponsored the Basic Chemicals Committee formed by the War Department under the Chairmanship of Brigadier R. D. T. Woolfe and with a distinguished membership of scientists, technologists, and industrialists. This Committee's report brought out the gaps which existed in this country's basic chemicals production to meet fully the defence as well as the civil requirements. Sir Clarence gave not only an impetus but spared also no efforts to expand the chemical industry, particularly heavy chemicals and coal tar and its distillation products by persuasion, and where necessary, by judicious pressure.

Being a great engineer himself, Sir Clarence has devoted his attention to the planning and establishment of a sound system of technical education particularly from the point of view of providing an adequate flow of technical recruits for the army both officers and other ranks.

Dignified and amiable, Sir Clarence represents the best type of Englishman. His kindly and genial temperament, humour, unfailing courtsey, readiness to help, tact to handle difficult situations and sense of justice have won the admiration of all those who had the privilege of coming in contact with him.

THE TENTH PAVLOV CONFERENCE*

THE tenth Pavlov Conference on physiological problems was held in Moscow from 29th March to 2nd April under the Chairmanship of Academician Leon Orbeli, Vice-President, Academy of Sciences, U.S.S.R. The Conference was organised by the Biology Section of the Academy.

Unfortunately all Pavlov's pupils were not able to attend as they did the previous conferences in order to discuss their work and achievements on the analysis of the Master's heritage. Nevertheless, the Conference became a kind of a congress of physiologists.

Some fifty papers were presented at the Conference. This was the first conference since the war began. In general the Conference was called to exchange experiences of physiologists who have turned their study to pathophysiological problems since war began because of the material presented by war injuries to the nervous system. In this way physiologists have been able to work for the benefit of their country by seeking means to promote rapid treatment and cure of the wounds and at the same time have accumulated much new data and enriched the science of neural physiology.

Deserving of special attention are the papers read by Professors P. K. A. Nokhin, A. R. Lurye, N. I. Graschenkov, T. P. Mayorov, V. V. Stroganov, and scientific workers V. V. Pavlov and E. E. M. Sosuntsova. During their observations and experiments on patients physiologists have discovered a number of new facts and have been able to give already known facts a physiological interpretation. In this respect special interest was aroused by the paper read by Professor P. K. A. Nokhin on distribution of higher nervous activity in dogs following the removal of the frontal part of the brain cortex, and the paper which followed immediately after it was read by Professor A. R. Lurye on nervous disorders following injuries to the frontal part cortex in man. The former showed by means of combined motor and secretor methods that removal of frontal sections of cortex, while it left secretor and simple motor reactions untouched, made itself felt, in fact, that it was impossible to stop motion, forming part of complex action once it had been started. The latter showed in a number of patients the impossibility of stopping movement and disruption.

In addition to purely physiological interpretations some speakers at the Conference were able to give details of the excellent results of the therapeutic measures they had adopted, for example, in curing deaf-mutism resulting from concussion (90 per cent. cures, Professor A. G. Ivanov Smolensky), and work on new methods of diagnosis of diseases of cerebellum (M. B. Tetyeeva and Peed Yankovskaya).

Great interest especially on the interpretation data obtained was shown in the paper read by Prof. V. K. Petrova, an old colleague of Pavlov who is now seventy years of age. She has worked on the dogs for fifteen years subjecting some to various nerve traumas and carefully guarding others against any sort of nerve injury. Professor Petrova noted that dogs suffering from nervous injuries have all grown decrepit while healthy dogs still look comparatively young, that they did not show grey hairs, bald spots and affected teeth. The former in addition also suffer from skin diseases and cancer-like tumors.

Dr. M. I. Livanov who is continuing Pavlov's work on conditioned reflexes has obtained these reflexes from changes in electrical activity of brain cortex; Professor Y. P. Frolov, also continuing Pavlov's work has obtained conditioned reflexes from muscular contraction in lungs of tortoises.

Work on unconditioned reflexes and instincts was detailed in papers by Professors S. A. Vassiliev, A. A. Mashkovtsev and V. Krushinsky. Vassiliev gave experimental explanation for the mechanism which causes birds to take dust-baths and showed that birds which have been deprived of their voices continue to perform all actions necessary when singing as though voice were still functioning. Professor Mashkovtsev gave the Conference excellent results of his work on the decrease in percentage of barrenness amongst domestic animals; Krushinsky showed that difference between wildness and tameness in grey and white rats depends to a considerable extent on development.

Amongst other papers read were those by Professor G. B. Gershun who showed that when patient is unconscious resulting from concussion, and exciters continue to affect the central nervous system and are reflected in electrical impulses in brain cortex but do not affect consciousness of patient; by L. S. Gdrshelva who showed that absence of cerebral hemispheres in doves leads to birds being considerably less affected by carbon dioxide poisoning than is the case in normal birds; by M. I. Saprokhin who showed convincingly that not only cerebellum affects vegetative nervous system but that vegetative nervous system also affects cerebellum.

Great interest was also displayed in work of those who were at the Conference and who are not amongst actual pupils of Pavlov: Academician L. S. Stern, Professors H. S. Koshtoyants and N. I. Grashchenkov, both corresponding members of the Academy, and Professors M. M. Zevadovsko, E. B. Balsky, A. A. Magnitsky; S. D. Klencharev, leading Therapeutist and R. Lurye, Physiologist.

---

* Proceedings of the Conference on Physiological Problems dedicated to the memory of Ivan Pavlov, cabled by the Soviet Scientists' Antifascist Committee for publication in *Current Science*.

CHEMOPROPHYLAXIS IN MALARIA

BY U. P. BASU, D.SC., F.R.S.
(*The Bengal Immunity Research Laboratory, Calcutta*)

MALARIA, the most widespread of all the diseases prevalent in India, causes the greatest amount of morbidity and mortality in the country. The number of individuals that suffer from malaria every year, has been estimated at a minimum of 100,000,000 amongst which nearly one million die of it per year. For the interests of public welfare as well as for the general development of the country attention should be directed to the prevention of the disease in individuals. The growth of *Anopheles* mosquito that is responsible for the spread of malarial infection must be checked. This may be done by destroying the breeding centres and by killing the adult stage of the mosquito. Of course, there would take time to materialise. A chemoprophylaxis might then be a better method for controlling the infection throughout the length and breadth of the country.

Quinine is the common antimalarial and is in general use. But it must be taken in doses that would relieve symptoms. Taking this at a minimum of 45 grains, a rough approximation of the annual requirement for India would be (100,000,000 × 45) grains, or, approximately more than 6,00,000 lbs. The average production in India, however, comes to about 90,000 lbs. To this we may add the amount which India imports every year. This on average is found to be 1,10,000 lbs. per year before the war. It thus appears that the consumption of this antimalarial is at best one-third the estimated requirement. From the report of Wilson and Mirchandani on the prospects of cinchona cultivation in India, it may be found that there are enough suitable land in India for cinchona plantation to meet the total requirement of quinine. It is difficult to understand why plantations are still not being started on an extensive scale. The cinchona plants take some years to mature and the maximum content of the alkaloid occurs in trees between the ages of seven and eleven years. In spite of new plantations which might immediately be started, we would have to depend on the imported quinine for years to come. But even then it is difficult to meet the heavy demand of the country with imported quinine from abroad, as the world production of quinine is believed not to exceed 2,000,000 lbs.—Java alone supplying 90 per cent. of the above production. However, when this most valuable remedy in controlling the disease in man, is not yet available in sufficient quantities, we should search for other remedies to eliminate this evil.

It may be noted that in spite of the various measures such as destroying the larval stage of the mosquito by Paris Green or some oil, killing the adults by insecticide, or, protecting the human beings by administration of antimalarials, malaria as a disease is not diminishing to any extent. On the contrary in wartime its fury further increases in virulence. As no immuno-therapy is possible in the treatment of malaria, the most promising line of attack would be by means of chemotherapy. It would have been ideal if a compound would have been available that might have prevented the inception of an infection when a man has been bitten by an infected mosquito. No such compound is yet known and as such a true prophylactic measure cannot be followed.

The next step would be to attack and destroy the malaria parasite in the various stages of development in the human body. Quinine as well as certain synthetic acridine derivatives (Atebrin, Atabrine, Mepacrine or Alcerin) remove schizonts from circulation. But these have no effect on gametes. The drug plasmochin—a quinoline compound is the only gameticide in vogue. Similar other quinoline derivative is also now being found to exert a definite and often better gametocidal action. In spite of treatment with one or other antimalarial drug, some parasites are left in the body mechanism and may reappear in the peripheral circulation causing a relapse at a subsequent interval; *P. falciparum* (tropical malaria) persists after an attack for a year only, the *P. vivax* for two and half years and the *P. malariæ* upto seven years. So the problem in the treatment of malarial patients, would be to find out a therapeutic agent that would destroy the parasites that might have entered into the fixed tissues (probably the reticulo-endothelial cells) and thereby lower down the cause of relapses. Naturally, what is wanted for true chemoprophylaxis is a drug that would act equally on all the above stages of the parasite, or, at least a drug that would prohibit the inception of a malarial infection. It should, of course, be less toxic, more active, readily produced and easily available to the mass. Under these circumstances then, the menace in question be removed or at best checked to a considerable extent.

As it stands at present, there is no drug to prevent infection. Quinine and Atebrin like compounds, however, are good schizonticides, and as such, are in heavy demand. The rate of production of quinine and its availability in India, as indicated above, cannot satisfy India's requirements. The only other immediate remedy lies in the production of the synthetic schizonticides. It is now well known how these can be produced. The most important chemicals required, are toluene, benzene, acetone, acetic acid, nitric acid, hydrobromic acid, alkalies, fusel oil, chloroform, benzene, phosphorous oxychloride, thionyl chloride, chlorine, metallic sodium and diethylamino ethanol (or, simple diethylamine). There is no secrecy in the mode of production and every one can produce it. The point is how to obtain the product in quantities to meet India's demands. As 1·5 gram of this antimalarial is required for one course of the treatment, 100,000,000 sufferers in India would require roughly 3,500,000 lbs. To achieve this production our chemical industries would have to supply all the above chemicals costing many

million pounds. Certain of these chemicals, of course, would be easily available, some like toluene, benzene, acetone, fusel oil, etc., are being produced, but on account of Government control their supply is restricted. Metallic sodium, phosphorous oxychloride, thionyl chloride and diethylamino ethyl alcohol are not available at the present moment and have to be imported from abroad. The full requirement for India would necessitate the purchase of 3,150, 4,000, 7,470 and 4,000 cwts. respectively of metallic sodium, phosphorous oxychloride, thionyl chloride, and diethylamino ethyl alcohol approximately. Previously America too synthesized the antimalarial from intermediates imported from Germany. If the start that has already been made in India be encouraged, there is no reason to believe why in very near future India would not be able to satisfy her own requirements by manufacturing all the materials that are necessary within the country itself.

It is quite natural and possible that by producing the synthetic antimalarials and cultivating the cinchona plants wherever possible, we can supply enough materials for suppressing the malarial attack in every part of the country. In the meantime extensive investigations and co-operative research may be carried out throughout the various research institutes to find out a sporozoiticide that would be a true prophylactic, and prevent malarial infection in future.

FORECASTING AND ESTIMATION OF CROP YIELDS

By V. G. PANSE[1] and R. J. KALAMKAR[2]

FORECASTS and estimates of yield of commercial crops like cotton, jute or sugarcane are of considerable importance to the trade and industry, because the availability of raw materials during the season is the basis of all calculations of manufacturing processes. With the increasing emphasis on 'planned' production, a still greater value will come to be attached to reliable estimates of yield, while in an emergency, like the present, arising out of war conditions, accurate forecasts and estimates of production are a paramount need for ensuring sufficiency of food grains and their equitable distribution in different areas. In India, where tax on agricultural land forms the principal source of Government revenue, the Government administration is specially interested in forecasting and estimation of crop yields.

Forecasts or estimates of most probable production are made while the crop is still standing in the field, whereas the actual production is estimated at or soon after harvest. The latter may be treated as a more accurate forecast concerning the movement and arrival of the crop to the market during the season. Estimation of production involves a knowledge both of the average yield per acre and of the total acreage sown with the crop. In England and the United States of America crop forecasts are made by a large number of voluntary reporters who are in close touch with the farming of their respective areas. In America, crop reporters are required to estimate both the yield per acre and the acreage under the crop; but in England acreage figures are obtainable precisely, since compulsory returns for all holdings are made to crop reporters. Except in permanently settled districts, an elaborate Government organization extending to the remotest village looks after crop forecasting in India. Each village has a *patwari* or an accountant who is also the crop reporter. His estimate of seasonal yield is usually expressed as a fraction of the normal yield; a method similar to that adopted in America. Acreage figures are recorded in the village register, which contains a list of all fields in the village, their dimensions and areas sown in each field with different crops each season. Area figures for different crops are consequently known with a high degree of accuracy.

The chief defect of the present methods of forecasting yield in India as well as in other countries is that no objective procedure is employed in arriving at the estimates which are merely opinions of individuals as to what the yield is. The normal yield, which forms the basis, has no precise definition. In America it is understood to represent yield better than the average but less than the maximum. In India, a certain number of crop cutting experiments are conducted on selected plots of land; but a straight average of these experiments is not taken as the normal yield. The figure adopted is based on selected results coupled with local information and opinions of revenue officials. In the absence of accurate estimates of final yield it is usually impossible to judge how closely the forecasts represent true yield. For commercial crops, independent data relating to yield are available through records of arrivals in markets or at factories; but these are ordinarily far too incomplete to provide an effective check on the forecast estimates. For grain crops even this information is lacking. It is frequently argued that the judgment of a skilled and experienced observer regarding average yield cannot be much wrong; but this contention has not been borne out whenever it has been put to a test (Yates, 1936; Irwin, 1938). Yates (1936) has given interesting examples of how forecasts based on a casual inspection of the crop can go badly wrong, and how biased results are produced either by attempting to choose deliberately an average sample or by omitting to follow an objective procedure in sampling. Agreement between different observers is no guarantee that the estimate represents the true average closely. All or majority of them may systematically under or over-estimate it. This bias can be allowed for only if its magnitude and direction can be shown to be fairly constant.

1. Institute of Plant Industry, Indore. 2. Department of Agriculture, Central Provinces.

To be of any real service, both forecasts and estimates of yield must be free from bias and largely free from accidental errors to which all estimates are subject. The efficiency of present methods of crop estimation in this respect needs testing, and the employment of objective procedures for this purpose, if not for replacing present methods altogether, are attracting increasing attention of Government departments concerned everywhere. To secure unbiased estimates, random sampling, which gives every member of the population an equal chance to contribute to the estimate, is the only known method available, and if the sampling is sufficiently extensive, accidental errors can be reduced to any desired level. Estimation of crop yield at harvest falls very properly within the realm of application of this kind of sampling. The problem of forecasting can be dealt with by the same method, though estimation is rendered more difficult here, because it must be based only on measurable characters of the standing crop. The underlying statistical theory is simple and is explained in considerable detail by Cochran (1939) in relation to the present subject.

Recent attempts to determine the yield of wheat in several districts of Great Britain and in a portion of North Dacota State in the United States by harvesting and weighing small samples of the crop in randomly selected fields are described by Cochran (1939) and by King and Jebe (1940) respectively. Due probably to the preliminary nature of the experiment, farms were not selected at random in England, while in North Dacota, a perfectly random selection of fields was considered impracticable and route sampling was adopted as a substitute. The unbiased character of the resulting estimate of yield and the validity of its sampling errors thus become suspect due to these deviations from strict randomization in both the cases; but nonetheless these surveys provide excellent illustrations of the application of the principle to the commercial crop.

In India, difficulties of adopting full randomization, whatever their nature and extent in America and England, are not insuperable, thanks chiefly to the existence of the Government land revenue machinery. A recent noteworthy attempt to employ this procedure in a large-scale agricultural survey is due to Mahalanobis (1939, 1942), who applied it to the problem of estimating the annual area under jute in Bengal, where due to the Permanent Settlement no village staff is available to carry out complete enumeration of area under different crops, a practice which prevails in other provinces. In devising a suitable sampling technique, Mahalanobis is primarily concerned with the evaluation of the relationship between the size of sampling unit and variance between samples, and through field as well as laboratory sampling he devises an empirical function which he terms the variance function analogous to one shown by Fairfield Smith (1938) from uniformity trials. A second similar relationship, the cost function, is further worked out between cost on the one hand and variance and size and density of samples on the other. He proposes to employ the same approach to the problem of estimating yield, though actual results of any such project do not appear to have been published yet.

This method, though interesting mathematically, appears to be of limited utility in connection with the practical problem of sampling for estimation of yield. Exploratory surveys are needed to ascertain the form of the cost and variance functions and to find the numerical values of the statistical constants of these functions. This creates an impression in the minds of administrators and other laymen that complex, time-consuming and expensive research is necessary before practical recommendations can be made about the sampling procedure to be followed. In the jute area survey, preliminary work covering an area of some 2,300 sq. miles, or rather less than the size of one revenue district, involved an expenditure of 155 thousand rupees in a period of three years and an actual survey of all districts growing jute, with a total area of 59,000 sq. miles, cost the same amount of money in one season. The cost in either case was equally divided between field work and statistical analysis. Since the level and variability of crop yields change from season to season and from tract to tract owing to the influence of various environmental factors, it cannot be expected that the variance and cost functions determined from sample data over a restricted area will predict with any great exactness the optimum type of sampling for different tracts and in different seasons (H.O.H., 1941). Estimates of cost based on these functions are not likely to be realized even approximately in practice, when it is considered that the field work on the recommended plan will ultimately be in the hands of the permanently employed revenue and agricultural staff. This condition also implies that a simple and uniform procedure will be highly advantageous. The utility of these functions in providing guidance in sampling for yield estimation will thus not be commensurate with the time and money spent in investigating them.

In fact, if objective methods of crop estimation are to be introduced in India without further delay, we must not place an undue emphasis on the matter of 'technique'. For adopting random selection of sample plots, which is the main feature of such methods, no investigation is required. It is really a question of convincing the Government departments concerned that replacement of the present personal selection of plots by a random selection is both essential and feasible. The optimum intensity and distribution of the sample plots in relation to the particular standard of accuracy desired for the final estimates of yield will, however, have to be determined by experiment. The effect of size and pattern of the sampling unit on the accuracy of the final estimate is of a secondary importance, as the sampling error from this source is only one of the components of error to which the estimate is subject. Commonsense consideration and past experience indicate that the magnitude of this sampling error will be small compared to variation from other causes. Crop estimating surveys can be planned in such a

manner that while the primary objective of estimating yield in the region surveyed is achieved with a known degree of precision, information calculated to increase the efficiency of future surveys both with regard to statistical accuracy and cost is also secured simultaneously. The aim should, of course, be to obtain estimates of yield with the requisite level of accuracy at minimum cost, but progress in this direction will be ensured on the basis of extensive observations made through successive surveys, rather than as a result of special preliminary inquiries in restricted areas. The principle is illustrated below by a brief description of the survey carried out in the year 1942-43 for estimating the yield of cotton in Akola District in Central Provinces. The experiment cost a moderate sum of Rs. 6,000.

The District has an area of 4,092 sq. miles and contains 1,734 villages. It is divided into six administrative subdivisions (*tahsils*). The total area of some 600,000 acres under cotton is distributed among the six *tahsils*, ranging between 69,000 and 137,000 acres per *tahsil*. The number of villages in one *tahsil* ranges from 186 to 348. Cotton is grown in all villages and it is ordinary *Oomra* (*G. arboreum* var. *neglectum* forma *bengalensis*) or its superior strains, Verum 434 and Jarilla. The crop is sown in June on the commencement of the monsoon and is harvested from November to February in five or six pickings. The plan of the experiment was as follows.

In each *tahsil* ten random villages were selected and from a list containing survey numbers of all fields growing cotton in the selected villages in 1942-43, two random fields were selected in each village. In each of these two fields, two plots, measuring 81 ft. × 162 ft. $= {}^3/_{10}$ acre were randomly located. Random selection of villages, fields and location of plots was made with the help of Tippet's random numbers (1927). For harvesting, each plot was subdivided into six longitudinal sections of ${}^1/_{20}$ acre size. Yield data of 240 subplots in each *tahsil* or 1,440 plots in the whole District were thus obtained. Besides the *kapas* (seed-cotton) yield of the individual sub-plots, the number of plants, the number of bolls per plant and boll weight were also recorded in small sample units in one of the two experimental fields in each village. The analysis of variance of plot yields (sum of six ${}^1/_{20}$ acre sections) in each *tahsil* pooled over the whole District is shown below.

Analysis of variance of plot yields

Due to	Degrees of freedom	Mean sq.
Villages	54	1595
Fields	60	1150
Plots	120	154

While the magnitude of variation differed in the individual *tahsils*, the relative magnitude of variation from the three sources was more or less similar in most *tahsils*. It should be noted that the mean squares for the fields and villages in the analysis of variance include, besides the real variation due to these items, the sampling variation, since the yields of fields were measured only by sample plot yields, and village yields were based on those of a few randomly selected fields in each village. The real variation between villages is represented by the excess of the mean square for villages over that for fields, and the difference between the mean squares for fields and plots provides an estimate of the real variation due to fields. We thus see that variation from field to field is clearly the most dominant factor affecting the mean yield of a *tahsil*. There is a certain amount of additional variation due to differences between villages; but compared to these two factors, variation between plots in the same field is very small. This relationship between the three variances forms the basis for devising a sampling technique capable of giving yield estimates with a desired degree of accuracy. It is clear from the analysis of variance that the precision of mean yield will depend most on the number of fields sampled and least on the number of plots laid out in each field. Statistically the standard error of the mean yield is related to the variances from the three sources by the formula,

$$Vm = \frac{V}{n} + \frac{F}{nk} + \frac{P}{Nnk},$$

where Vm is the desired variance of square of the standard error of the mean yield, V, F and P the true variances due to villages, fields and plots and n, k and N the number of villages, fields and plots respectively. The estimates of true variances obtained from the present data are

$$\text{Due to villages (V)} = \frac{1595 - 1150}{4} = 111 \text{ per village.}$$

$$\text{Due to fields (F)} = \frac{1150 - 154}{2} = 498 \text{ per field.}$$

$$\text{Due to plots (P)} = 154 \text{ per plot.}$$

By substituting these values in the formula above, the amount of sampling and its optimum distribution for securing a given degree of precision for the mean yield can be determined. To illustrate this on the basis of the present results, the average yield will have a standard error of 5 per cent., *i.e.*, this average will be subject to a maximum chance fluctuation of 10 per cent. on either side of the estimated value, if the following sampling is adopted.

Number of villages (n) required to give 5 per cent. s.e. of mean

No. of fields per village (k)	No. of plots per field (N)	
	1	2
1	194	175
2	111	101
4	70	65
8	49	47
10	45	43

The relative importance of the number of plots per field and of the number of fields per village in determining the number of villages is clearly brought out in this table. The number of villages shown above refers to the whole region whose mean yield is required to be determined with a standard error of 5 per cent. It may be a single district or all cotton-growing districts in the province taken together. In the latter case, the accuracy of mean yields in the individual districts will be naturally much less. Subdivision of the area sampled into smaller units such as *tahsils* of a district is important both for administrative convenience and for securing increased accuracy of the final mean since errors are usually of different magnitudes in the different subdivisions.

The subdivision of plots into $^1/_{30}$ acre sections was intended to provide information on the relative merits of plots of different sizes. Three plot sizes $^1/_{30}$, $^1/_{10}$ and $^3/_{30}$ acre could be compared as in a uniformity trial and the coefficients of variation were found to be 24·1, 20·0 and 18·1 respectively. While there is thus a gradual reduction in error as plot size is increased its magnitude is not appreciable, and when other factors which contribute to the ultimate error of the mean yield are taken into account, it does not appear that the choice of a particular plot size in preference to another is likely to be of any importance in increasing the accuracy of mean yield. Questions of practical convenience will then determine the plot size to be adopted and $^1/_{10}$ acre plots which are at present in use appear quite satisfactory. By replacing $^3/_{10}$ acre plots used in calculating the number of villages required to give a 5 per cent. standard error of the average yield shown in the table above by $^1/_{10}$ acre plots, no material change was observed in the figures.

The cost of field work may be divided into two parts, one being the cost of harvesting which will depend on the total area harvested, *i.e.*, on the total number of plots, and the other would include the cost of travelling and supervision. To save travelling from village to village it is clearly advantageous to reduce the number of villages and increase the number of fields per village. The question of minimum or optimum cost can be examined theoretically; such examination, however, is of little value unless the data on which it is based refer to the routine adopted in practice and not derived from a special inquiry. But with the large-scale adoption of this method for estimating yield relation between cost and statistical accuracy must receive increasing attention with the aim of minimising costs required to attain a prescribed degree of accuracy in the estimates.

The present survey was designed to fulfil the twofold objective of giving an unbiased estimate of the average yield of cotton in Akola District in the year 1942–43 and providing information essential for increasing the statistical efficiency of future surveys. The average yield per acre for the whole district was estimated from the survey at 136 lbs. of seed cotton and this had a standard error of 6·3 per cent. Taking into account the acreage under cotton, the estimated total production of cotton in the district came to 72,652 bales (1 bale = 392 lbs. of lint). It is important to note that the official estimate was over 41 per cent. higher than this figure and well outside the range of chance fluctuation of the experimental estimate. There can be little doubt that the former was a serious over-estimate of the production. On the other hand, it is interesting to record that the cultivators whose fields were sampled in the survey under-estimated their yield by 26 per cent.! With the help of the technical information now available, it is possible to raise the accuracy of the yield estimates, at the same time simplifying the sampling procedure. For instance, without any alteration in the number of villages or the total area harvested, we may introduce the modification that instead of having two plots in each field and two fields per village only one plot needed be located in each field and the number of fields per village increased to four. This is expected to reduce the standard error considerably. A further simplification would result from adopting a uniform plot size of $^1/_{10}$ acre and not subdividing it into sections for harvesting. The yield survey for Akola in 1943-44 was planned on these lines and a more accurate estimate of yield is anticipated without any increase in cost. For verification of the technical results, the survey was also repeated with the previous design in another district.

Forecasting of yield from the standing crop before it is harvested is of considerable importance to the trade and such forecasts based on the inspection of the crop are issued officially. The present survey provides some useful information on the accuracy of forecasts and the means of improving them. The forecast estimates of yield of the fields selected for the survey were made by the inspector in charge of the survey who was accustomed to making such estimates by eye judgment. He over-estimated average yield by 31 per cent.; but apart from this bias his estimates showed a fairly high correlation ($r = \cdot 8$) with actual yields. Corrected for bias, these forecasts would thus provide tolerable estimates of probable yield; but it cannot be assumed that either the magnitude or the direction of bias would remain constant in future seasons or in other districts. Experience elsewhere indicates that the bias changes in an unpredictable manner and it consequently appears impossible to prescribe a correction in advance. More reliable forecasts of yield should result from the use of objective methods such as quantitative observations on the yield constituents of the standing crop. This is particularly feasible for cotton where it is easy to count the number of plants in unit area, the number of mature bolls per plant and, when picking commences, the weight of seed cotton per boll. These observations were made in the present survey but it is not intended to discuss them here beyond mentioning that they did not, contrary to expectation, show a closer association with actual yield than eye inspection and frequently the latter proved superior. The

most probable explanation is provided by the fact that the observers were instructed to count those bolls which in their judgment would open during the harvesting season and contribute to yield; but this led to considerable variation in practice, some observers including in their count quite small bolls, others excluding considerably developed ones. More precise instructions are obviously needed on the type of bolls to be counted. The investigation is being continued.

This brief account of the cotton survey is presented to illustrate the application of the random sampling method to commercial crops as the most reliable means of estimating their yield. It is satisfactory to note that rapid progress is being made in the adoption of this method and sufficient data will soon be available for a more detailed discussion of its various aspects. Besides the extension of the cotton survey to two districts in Central Provinces in the past season, an investigation on similar lines was projected in two districts, one in the Central Provinces and the other in the Punjab, for estimating the yield of wheat. Two large-scale surveys embracing the whole provincial area under wheat were also carried out in the Punjab and the United Provinces last year. Immediate expansion of such yield surveys on a still wider scale can be recommended without hesitation; because the design described above has the advantage that besides giving unbiased estimate of yield for the area surveyed, it also provides data which form the basis for introducing such modifications in the plan of future surveys as are calculated to improve their efficiency. This improvement can go on steadily without in any way affecting the value of previous results. To achieve this end, it is most important, however, that the procedure adopted and the statistical results obtained should be under continuous review by a competent statistician charged with this work and not merely called in to give advice when difficulties arise. At present a number of crop cutting experiments are carried out by the staff of the revenue and agricultural departments and this personnel may be organised and utilized for field work under the new plan.

Not only for estimating yield, but for a variety of other investigations such as the effect of meteorological factors on crop, the spread of diseases and pests, spread of improved varieties of seed and other agricultural improvements, social and economic inquiries among the rural population, random sampling surveys on the pattern described here provide the most satisfactory means. A beginning in this direction is urgently necessary because past surveys of this kind have been frequently and justifiably criticized on the question of their respective character and the accuracy of their results.

The present survey was financed by the Indian Central Cotton Committee.

1. Cochran, W. G., *J. Amer. Stat. Assn.*, 1939, **34,** 492–510. 2. Fairfield Smith, H., *J. Agri. Sci.*, 1938, **28,** 1–23. 3. H. O. H., *Plant Breeding Abstracts*, 1941, **9,** 71–72. 4. Irwin, J. O., *Suppl. J. Roy. Stat. Soc.*, 1938, **5,** 1–45. 5. King, A. J., and Jebe, E. H., *Research Bull. 273*, Agri. Expt. Station, Iowa, U.S.A., 1940, 624–49. 6. Mahalanobis, P. C., *Sankhya*, 1939, **4,** 511–31. 7. —, *Presidential Address*, Indian Science Congress, Baroda. Section of Mathematics and Statistics, 1942. 8. Tippet, L. H. C., "Random Sampling Numbers," *Tracts for Computors*, No. XV, 1927, Cambridge University Press, London. 9. Yates, F., Manchester Statistical Society, 1936, pp. 1–26.

PENICILLIN—NEW WAY OF MANUFACTURING DRUG

VARIOUS reports on home-made penicillin have appeared in the medical Press, but it has been pointed out that there are dangers in the uncontrolled use of this remarkable remedy, writes *The Times* medicinal correspondent.

He adds: A new account of an easy way to make penicillin, appearing in the current issue of the *British Medical Journal*, however, gets over the difficulties in that the produce described has been prepared and tested in a bacteriological laboratory. The author, who works at a London County Council hospital, records that a strain of penicillin, the parent substance used, was supplied by Professor Fleming, discoverer of the drug.

A mould is grown in a special solution and the filtrate obtained is carefully tested and assayed and then used without further manipulation usually as a form of local application. The whole method has the merit of simplicity and can be carried out in any bacteriological laboratory with well-trained staff. Some 24 patients have been treated by local application and in 19 cases the results have been wholly satisfactory.

It is thought that this product can be used for local disease until more refined products are made more generally available.—London, by cable.

OBITUARY

Dr. J. McKEEN CATTELL

WE deeply regret to record the death of Dr. McKeen Cattell, Editor of *Science* for nearly half a century, on the 20th January 1944, at the age of eighty-four. Formerly he was the Professor of Psychology at Columbia University.

In 1935 he was invited to accept the corresponding Editorship of *Current Science*. In accepting the invitation he wrote, "I greatly appreciate the honour of being invited to act as an associate editor of *Current Science* which is doing so much to advance the appreciation of Science in India. It gives me pleasure to accept and I shall do what I can to be of assistance in your work".

In the death of Dr. Cattell scientific journalism has lost one of its distinguished editors and *Current Science*, a valued and friendly supporter.

LETTERS TO THE EDITOR

A NOTE ON THE GENERALIZED VARIANCE OF MULTIVARIATE POPULATIONS

IN the case of multivariate populations the generalized variance for all practical purposes takes the place of the variance of single variate populations. This is obvious when we consider Fisher's t^2 and Hotelling's T^2. The present note gives the relationship between the generalized variance and the residual variances (on the basis of the size of the sample and not on the degrees of freedom) of the regression equations between the various variables.

The determinant

$$\begin{vmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{vmatrix}$$

where $a_{ij} = \frac{1}{N} \Sigma (x_{ir} - \bar{x}_i)\ (x_{jr} - \bar{x}_j)$, is called the generalized variance of a multivariate sample of size N and of n variables.

It can be shown that the above determinant is equal to

$$s_1^2\ s_{2\cdot1}^2\ s_{3\cdot21}^2 \cdots \cdots s_{n\cdot12\cdots n-1}^2,$$

where $s_{r\cdot12\cdots r-1}^2$ is Yule and Kendall's* notation for the residual variance of x_r expressed as a linear function of $x_1, \ldots\ldots x_{r-1}$.

The importance of this result lies in the fact that it will lead to the solution of various distribution problems connected with multivariate population without resorting to hypergeometry.

Imperial Agricultural Research Institute, New Delhi, P. V. KRISHNA IYER.
April 19, 1944.

* Yule, G., Udny and Kendall, M. G., *An Introduction to the Theory of Statistics*, Griffin & Co., Ltd., London, 1940.

THE PRINCIPAL MAGNETIC SUSCEPTIBILITIES OF METAL CRYSTALS

MOST of the work on the determination of the principal magnetic susceptibilities of metal crystals has been carried out by preparing single crystals in the form of long rods.[1] The crystal is usually mounted with the long axis perpendicular to the magnetic lines of force of a magnetic field. The Gouy force on the specimen is studied at different orientations, when it is rotated through 360° about its long axis. From these results it is possible to calculate the principal magnetic susceptibilities, provided we know also *either* the angle ϕ between the principal crystalline axis and the long axis *or* the magnetic susceptibility of the polycrystalline specimen. The susceptibilities obtained by the Gouy method are volume susceptibilities. To determine the mass values, the density of the material has to be determined. It is well

known that the actual determination of the density value causes considerable error in the final values of the principal mass susceptibilities.

Shoenberg and Uddin[2] made small beads of bismuth crystals, fixed the trigonal axis by etching and determined the principal mass susceptibilities by the Sucksmith ring balance.

The very elegant torsional method developed by Krishnan[3] was applied by John[4] to the study of the temperature variation of the magnetic anisotropy of bismuth crystal. Further study of metal crystals by Krishnan's method appears to be of great value since the principal mass susceptibilities could be directly and accurately determined. If $\chi_{||}$ and $\chi_{\perp}$ are the mass susceptibilities parallel and perpendicular to the crystalline axis, Krishnan's method enables us to determine their difference $\chi_{||} \sim \chi_{\perp}$ directly. This difference is studied at different field strengths. Curie's method may then be employed to determine the mean susceptibility χ_{mean}, also at different field strengths. Since $\chi_{\text{mean}} = \frac{1}{3}(\chi_{||} + 2\chi_{\perp})$, it is easy to calculate $\chi_{||}$ and $\chi_{\perp}$ at different field strengths.

If the specimens contain traces of ferro-magnetic impurities, the principal mass susceptibilities may be determined, as usual, by extrapolating the χ, $1/H$ graphs.

Test experiments have been carried out with crystals of bismuth, zinc, cadmium and tellurium. The first three crystals have prominent cleavage in the basal plane. Small pieces from single crystal rods could be easily obtained. In the case of tellurium, the author and Govindarajan[5] had prepared tellurium crystals in the form of long rods, for magnetic measurements. One of these crystals, for which ϕ was 30°, was cut at the proper angle and the end faces of the small rods were etched. Bismuth and tellurium showed no ferromagnetic impurities while zinc and cadmium had minute traces. Very fine quartz fibres were used to suspend the crystals in the uniform magnetic field between the pole-pieces of a Pye electromagnet.

The results obtained are given below.

Crystal	Investigators	$\chi_{\text{II}} \times 10^6$	$\chi_{\text{I}} \times 10^6$
Bismuth	Focke[6]	− 1·053	− 1·482
	John[4]	− 1·05	− 1·45
	Author	− 1·058	− 1·495
Zinc	McLennan, Ruedy and Cohen[7]	− 0·190	− 0·145
	Rao[8]	− 0·202	− 0·149
	Author	− 0·206	− 0·147
Cadmium	McLennan, Ruedy and Cohen[7]	− 0·261	− 0·160
	Rao and Sriraman[9]	− 0·223	− 0·163
	Author	− 0·234	− 0·159
Tellurium	Rao and Govindarajan[5]	− 0·329	− 0·296
	Author	− 0·342	− 0·289

A careful estimate of the errors involved brings the margin of error in the author's values to one per cent.

It is found that the results obtained by Krishnan's method agree satisfactorily with those by other methods. In the case of tellurium, the present investigation confirms the small anisotropy previously recorded by Rao and Govindarajan.[5] It is proposed to apply this method to further studies of crystal magnetism of metals, particularly from the point of view of the influence of impurity traces on magnetic anisotropy.

I thank Mr. H. S. Venkataramian for much valuable help.

Department of Physics,
Central College,
Bangalore, S. Ramachandra Rao.
April 16, 1944.

1. For details see Bates, *Modern Magnetism*, p. 144. 2. *Proc. Roy. Soc.*, 1936, **A 156,** 687. 3. *Phil. Trans. Roy. Soc.*, 1935, 234, 265. 4. *Z. Krist.*, 1939, **101, 337** 5. *Proc. Ind Acad. Sc.*, 1939, **10,** 235. 6. *Phy. Rev.*, 1930, **36,** 319. 7. *Proc. Roy. Soc.*, 1928, **121,** 9. 8. *Proc. Ind. Acad. Sc.*, 1936, **4,** 186. 9. *Proc. Roy. Soc.*, 1938, **A 166,** 325.

VAN DER WAALS' COHESION CONSTANT

It has been known for a long time that there is a close relation between surface tension and Van der Waals' constants '*a*' and '*b*'. Van der Waals himself on certain assumptions deduced that

$$\sigma_0 = A_1 \theta_c V_c^{-2/3} = Aa/b^{5/3}, \tag{1}$$

where A_1 and A are constants, θ_c and V_c the critical temperature and critical volume respectively, and σ_0 is defined by the fundamental (empirical) relation

$$\sigma = \sigma_0 (l - \theta)^n, \tag{2}$$

θ being the reduced temperature and n a constant which is nearly equal to 1·2 for all unassociated liquids. Ferguson[1] in a recent paper has found that the experimental values of σ_0, θ_c and V_c are in better accord with the relation

$$\sigma_0 = 3{\cdot}12\ \theta_c V_c^{-0{\cdot}55}. \tag{3}$$

Recently we have been investigating the properties of liquids on the 'hole' model originally given by Fürth[2] and his collaborators in a series of papers. In this connection we were led to a simple *theoretical* relation between Van der Waals' cohesion constant and the surface tension. In a paper to be published shortly we have constructed and solved the Schrödinger equation for a 'hole' in a liquid and have determined the eigenvalues for its energy. The energy values E_n are given approximately by the expression

$$E_n = 3{\cdot}61 \left(n + \frac{7}{10}\right)^{4/7} \frac{\sigma^{5/7} h^{4/7}}{\rho^{2/7}}, \tag{4}$$

where h is the Plank constant and ρ the density of the liquid. The theory gives for the intrinsic pressure for Van der Waals' cohesion constant the expressions

$$p_0 = 2\cdot4\,\sigma\left(\frac{\sigma\rho}{h^4}\right)^{1/7} \quad (5)$$

$$a = 2\cdot4\,V^2\sigma\left(\frac{\sigma\rho}{h^4}\right)^{1/7}, \quad (6)$$

where V is the molecular volume of the liquid. A comparison between the theoretical and experimental values shows that the variation of 'a' with σ and ρ is as required by the theory but the constant of proportionality is nearly 0·6 times its theoretical value.

University of Delhi, F. C. AULUCK.
April 1944. R. N. RAI.

1. Ferguson, Allen, *Proc. Phys. Soc.*, 1940, **52**, 759.
2. Fürth, R., Ornstein, L. S., and Milatz, J. M. W., *Proc. Amsterdam Acad. Sci.*, 1939, **42**, 107.

CATALYTIC FORMATION OF METHANE FROM CARBON MONOXIDE AND HYDROGEN—A STUDY OF NICKEL AND NICKEL ALUMINA CATALYSTS PREPARED FROM THE HYDROXIDE USING POTASSIUM, SODIUM AND AMMONIUM HYDROXIDES AS PRECIPITANTS

IN a humid mixture of carbon monoxide and hydrogen 1: 1 (roughly) by volume the following reactions took place in presence of nickel catalysts.

1. $2CO + 2H_2 = CH_4 + CO_2$.
2. $CO + H_2O = CO_2 + H_2$.

The influence of potassium, sodium and ammonium hydroxides used as precipitants for preparing the nickel catalysts on the relative rate of the above reactions if any was small and will be evident from the experiment No. 1_K 1_{Na}, and 1_{Am}, in Table I.

The effect of alumina as a promoter for favouring the reaction 1 was prominent and this is borne out by the comparative study of Table I with Table II where II_K, II_{Na}, and II_{Am} are alumina promoted catalysts. Moreover the promoter action of alumina depends on its concentration also. This will be clear if we compare Table II where the catalysts contain alumina to the extent of ·085 per cent. with Table III wherein the catalysts III_K, III_{Na}, and III_{Am}, the alumina content is 0·160 per cent. We find that concentration of the promoter for highest activity should be a figure which is lower than 0·160 per cent.

On the other hand Table IV will show that on addition of traces of potassium carbonate to the alumina promoted catalysts (II_K and II_{Am}) reaction 2 is preferentially accelerated.

Department of Chemistry,
Dacca University, K. M. CHAKRAVARTY.
January 11, 1944. J. M. SARKER.

Expt. No.*	Wt. of catalyst in gm.	Vol. of catalyst in reacn. tube in c.c.	% composition of reactants			Space vel. N.T.P. per hr.	No. of litres of gas passing	Reaction temp.	% composition of the resultants					CO_2-CH_4	$\frac{CH_4}{CO_2-CH_4}$ ‡
			% CO	% H_2	% H_2O				% CO_2	% CH_4	% H_2	% CO	% H_2O		
TABLE I															
I_K	·5028	3·77	30·31	38·77	31·27	206	25	387·2	21·32	15·01	26·72	2·68	34·27	6·31	2·39
I_{Na}	·5018	,,	29·70	39·51	30·87	205	,,	,,	20·85	15·17	26·82	2·58	34·58	5·68	2·67
I_{Am}	·4998	,,	30·47	38·51	31·02	205	,,	,,	21·66	15·46	25·70	2·78	34·41	6·20	2·48
TABLE II															
II_K	·5000	3·77	30·32	37·90	31·78	207	25	340	21·08	18·27	18·70	1·37	39·88	3·53	5·17
II_{Na}	·5000	,,	31·00	36·60	32·40	203	,,	341	22·74	19·20	15·69	0·98	41·39	3·52	5·51
II_{Am}	·4980	,,	29·96	38·28	31·76	208	,,	340·1	21·42	18·20	19·00	1·20	40·06	3·22	5·65
TABLE III															
III_K	·5008	3·77	30·10	37·65	32·25	207	25	339·1	21·74	17·52	20·01	1·40	39·33	4·22	4·15
III_{Na}	·5000	,,	30·68	37·17	33·29	207	,,	339·3	21·84	17·43	19·63	1·33	39·22	4·36	4·00
III_{Am}	·5004	,,	30·65	39·02	30·33	207	,,	339·5	22·37	17·99	21·39	1·34	39·91	4·38	4·09
TABLE IV															
$II_K + K_2CO_3$	·5007	3·77	20·49	58·83	20·68	207	25	340·2	22·67	18·76	19·77	0·49	38·28	3·91	4·79
$II_{Am} + K_2CO_3$	·5000	,,	20·45	38·43	51·62	207	,,	340·5	22·59	18·69	19·45	0·56	38·71	3·90	4·7[illegible]

* Suffix K, Na and Am after I, II, and III indicates that catalysts have been prepared under identical conditions using respectively KOH, NaOH and NH_4OH as precipitants.

‡ CH_4/CO_2-CH_4 indicates the ratio of the rate of reaction (1) to that of reaction (2).

A METHOD FOR THE ASSAY OF INDIVIDUAL ERGOT SCLEROTIUM

In previous communications on the subject,[1,2] one of the authors (B.M.) had stressed the need of ergot cultivation in India and recorded observations on the quality of Indian-grown ergot. Since then, satisfactory progress has been achieved in the production of medicinal ergot and further attempts are under way towards improving the strain of the fungus to yield higher alkaloidal contents.

In such efforts, as well as in the study of the medicinal value of various strains of ergot reported growing in Indian grasses,[3] one of the major handicaps has been the absence of a suitable micro-method for determining the alkaloidal contents of a few small ergot sclerotia. The B.P. method of colorimetric assay requires 12 gm. of ergot powder, a quantity hardly ever available for such experimental studies.

Bekesy[4] has described a method of analysing the alkaloidal content of individual ergot sclerotia but this reference could not be secured in India. An attempt was, therefore, made to devise a modified method based on the B.P. procedure using as small a quantity of ergot powder as is possible consistent with accuracy of determination. The following method appears to work well in our hands, though the results are only roughly quantitative. Fairbairn[5] has employed more or less a similar method for qualitative assay of ergot.

"Shake vigorously 0·1 gm. (0·05 gm. is also sufficient) of powdered ergot (usually obtained from 1 or 2 big ergot sclerotium) with 5 c.c. of a 5 per cent. sol. of Na_2CO_3 for a few seconds. Add 10 c.c. $CHCl_3$ and shake; filter through a plug of cotton wool to break the emulsion formed. Wash the clear $CHCl_3$ sol. with a little H_2O. Transfer 6 c.c. of this $CHCl_3$ to a test tube and add 3 c.c. of the following reagent (*p*-dimethylaminobenzaldehyde—0·1 gm.; H_2SO_4 35 per cent. v/v)—100·0 mils.; Sol. of $FeCl_3$ (5 per cent.)—1·5 mils.

The colour developed can be matched against a known strength of ergotoxine ethanesulphonate using the same reagent. The accuracy of the measurement is increased by using a Pulfrich photometer, in the same way as in the case of estimation of B.P. ergot."

Using this method, several readings have been taken with individual sclerotium from one batch of Indian ergot received from Coimbatore through the courtesy of the Government Mycologist, Madras. Figures (duplicate) were found to vary within wide limits, *e.g.*, 0·183 mg., 0·143 mg., 0·160 mg., 0·190 mg., etc., indicating that all sclerotia did not develop the active alkaloids to the same extent. The average figure for the batch came up to about 0·165 mg. by this method. By following the B.P. method, a figure of 0·145 mg. was obtained. This shows that the method of assay with small quantities of ergot is only a roughly quantitative method but nonetheless a dependable and workable one.

So far the alkaloidal content of ergots obtained from two grasses (*Chrosologon zeylanicus* and *Oplisimems compositus*) growing in South Indian hills (forwarded by the Government Mycologist, Madras) have been tested by the above method. The first gave a faint trace of ergot alkaloids, while the second gave negative results. Padwick and Agmatullah[6] have described two ergots found in the Simla Hills. One of them is on *Oplisimems compositus* but is reported to be different from *C. purpurea* and is named by them as *C. viridis*. This may be one explanation of the low alkaloidal content of ergots growing on grass hosts, as *C. purpurea* has long been known as the fungus which develops the medicinally important alkaloids in the ovary of the rye.

Biochemical Standardisation Laboratory, Govt. of India, Calcutta,
May 5, 1944.

B. Mukerji.
N. K. De.

1. Mukerji and Bose, *Sci. and Cult.*, 1942, **8**, 267. 2. — and De, *Curr. Sci.*, 1943, **12**, 87. 3. Pushkar Nath and Padwick, *Ibid.*, 1941, **10**, 488. 4. Bekesy, *Biochem. Zeitung.*, 1939, **302**, 187. 5. Fairbairn, *Pharm. Jour.*, March 13, 1943. 6. Padwick and Agmatullah, *Curr. Sci.*, 1943, **12**, 257.

EXTRACTUM PITUITARII LIQUIDUM FROM INDIAN CATTLE GLANDS

Considerable interests are now being focussed on the production of medicaments from glands available in India. One of the most essential drugs in this group is the posterior pituitary extract. It is an aqueous extract of the posterior lobes of pituitary bodies of oxen or other mammals and contains 10 International Units per c.c. According to B.P., Addendum 1936, the product should retain its potency for at least eighteen months after the date of manufacture. Recently Dey, Krishnan and Giriraj[1] have recorded the weight of pituitary glands as obtained in Madras, and have also prepared[2] dried posterior pituitary powder from the whole glands. In this laboratory the above powder is being systematically prepared for the last decade from cattle glands as collected from the Calcutta Corporation Slaughter House. In the table the weights of the whole pituitaries, fresh and desiccated posterior lobes, are being recorded along with those as found from American animals. The average potency of desiccated posterior pituitary powder as imported from abroad, has been found in our hands to vary from 82-90 per cent. in comparison with the International standard powder. The powder that is prepared in our own laboratory exerts on average a potency of 85 per cent. This on extraction with 0·25 per cent. acetic acid and on subsequent treatment affords the extractum Pituitarii

Type	Whole Pituitary		Weight of Posterior portion gm.	Desiccated powder	
	Number	Weight gm.		Weight gm.	Potency %
Foreign	100	225	25	4	82–90
Local	100	150	20	2·8	85

Liquidum. Each c.c. of this extract contains 10 International Units and maintains its potency for about three years.

From the above table it would be evident that though the potency of the dry posterior pituitary powder as obtained from the local glands is not at variance with that of the imported powder, the yield of the desiccated powder itself is about 30 per cent. less. Every precaution is taken in collecting, trimming, and drying the glands. In this connection references may be made to a previous observation by Basu, Bose and Das Gupta[3] on the lower yield of cholates from Indian ox bile. The question arises whether the active principles of the various glandular products from Indian animals can be further increased and/or improved by altering the breed and directing more attention to the nutrition as well as mode of slaughter of our domestic animals.

It has been noted by Dey *et al.*[2] that the annual requirements in India of posterior pituitary extracts correspond to about 2,500 gms. of the dried posterior powder. No mention has, however, been made of its standard and quality. Taking this to be of International standard the theoretical amount of units that might be obtained from the above powder, would be 5 million units.

Bengal Immunity Research Laboratory, Calcutta.
March 22, 1944.

U. P. Basu.
A. N. Bose.
S. C. Guha.

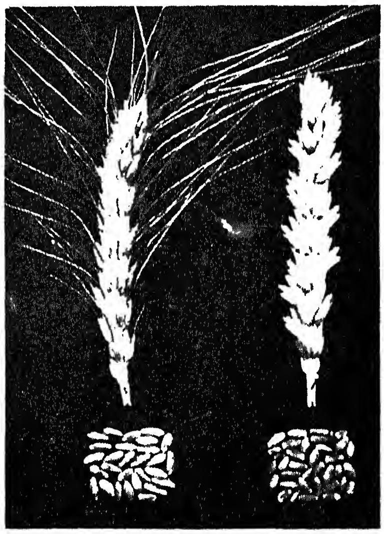
1. *Curr. Sci.*, 1944, **13**, 35. 2. *Jour. Sci. Ind. Research*, 1944, **2**, 87. 3. *Indian Med. Gazette*, 1940, **75**, 215.

A NEW QUALITY WHEAT FOR BOMBAY

The annual wheat acreage in Bombay Province covers an area of nearly 16 lacs of acres. The bulk of the area is under dry wheat and is concentrated in the north-central Deccan, north Gujarat and eastern Karnatak. Almost all of the main tracts have now suitable improved strains of dry wheats. The irrigated wheat area in the Province, however, varies from 1,50,000 to 2,00,000 acres annually, and although the area is comparatively small, it is scattered throughout the Province. The varieties of wheat under irrigation are Khapli (*T. dioccocum*), Baxi (*T. durum*) and Mondhya (*T. vulgare*), the latter being once the most extensively grown wheat. During the last twenty to twenty-five years, however, Pusa wheats have replaced the local irrigated wheats, especially the Mondhya variety. Of the various Pusa wheats, Pusa-4 (now I.P. 4) has spread very extensively, due mainly to its shorter period of maturity than local varieties, which helps it usually to escape steam-rust of wheat as well as saves the farmer an irrigation or two.

Although Pusa-4 has spread widely it has certain drawbacks. It shatters its grain rather easily if not harvested just in time. It does not tiller well and due to fewer leaves per plant the straw is coarse. Farmers, therefore, complain of its poor quality of *bhusa*. Moreover, Pusa-4 is an awnless wheat which affords it little protection against the attack by birds.

In the year 1932-33 Pusa-4 was crossed with a synthetic durum, Bansipli-809, with a view to combine the good characters of the two species. Bansipli-809 is itself a derivative from the cross of a synthetic Khapli, K. K. 568, and an improved durum strain, Motia (Bansi-168).



Niphad-4 Pusa-4

Bansipli-809 has black awns like Kala-Khapli-568, but unlike either Kala-Khapli or Motia varieties, it is an earlier maturing type. From

Table I

Milling and baking quality behaviour of Niphad-4 and its parents, Pusa-4 and Bansipli-809

Name of wheat	100 grain wt. gm.	Mottled grain %	Protein %	Feeds %	Straight run flour %	Loaf volume c.c.	Loaf type	Grain No.	Quality score %
N–4 (1942)	4·67	1·8	13·52	20·7	75·8	680	FH	6	85·0
N–4 (1943)	5·01	1·2	13·30	22·0	75·2	620	F	4	78·0
P–4 (1943)	4·38	7·4	13·40	23·6	73·0	510	FJ	3–4	65·0
Bansipli–809 (1943) ..	4·90	0·0	14·10	24·0	71·8	345	JK	3 Under-developed	36·5

[illegible] of B-809 and Pusa-4 pure breeding, [illegible] *vulgare*-like cultures were obtained in [illegible]-37. Comparative trials of these cultures with Pusa-4 for four years, from 1937-38 to 1941-42 at the Cereal Breeding Station, Niphad, showed that the culture 5-1-38-5 was the best. It was released for district trials in 1942-43 under the name Niphad-4. District trials in the Nasik and Ahmednagar districts of the Deccan and in the Kaira district of Gujarat showed that Niphad-4 was better in various agronomic characters than Pusa-4 and Pusa-52 respectively. At the Cereal Breeding Station, Niphad, as well as in the districts it has usually given 7 to 8 per cent more yield of grain than Pusa-4. Niphad-4 is more leafy and tillers more heavily than Pusa wheat and thus its *bhusa* is better than the latter.

Niphad-4 requires about 120 days from sowing to harvest, the life-period being more or less the same as that of Pusa-4. The awns of Niphad-4 are black at the base and glumes are white and hairy. These two characters would help to rouge fields of Niphad-4 as no other irrigated wheat in Bombay, except Baxi, possesses this character-combination. Baxi, however, is a durum wheat, and the shape of its ear and length of awns are quite distinct from those of Niphad-4. The full-awned condition of Niphad-4 affords it better protection from the attack of birds.

The grains of Niphad-4 are like those of a durum wheat; they are larger, 100 grains weighing nearly 5 grams as against 4·5 grams of Pusa-4. Unlike the Pusa wheat Niphad-4 does not shatter grains.

Like Pusa-4 the new wheat is also susceptible to all the known races of stem-rust in India and to remedy this defect it has been crossed with certain immune Kenya wheats.

In the year 1942 and again in 1943 samples of Niphad-4 were sent to Rao Bahadur Ramdhansingh, Cerealist, Department of Agriculture, Punjab, to determine its milling and baking qualities. With the second lot of Niphad-4, samples of seed of its parents—Pusa-4 and Bansipli-809—were also supplied. Comparative milling and baking data of Niphad-4 and its parents were kindly supplied to us by the Cerealist. The more important information is presented in the following table.

It will be seen from the above figures that Niphad-4 surpasses Pusa-4 in almost all the milling and baking attributes in both the years. It will be noted that Niphad-4 developes fewer mottled grains and its flour-yield is 3 per cent. more than that of Pusa wheat. The loaf-volume of the new wheat is much higher than that of Pusa-4 and in quality-score it considerably, outpoints the Pusa wheat. Ramdhan Singh[1] observes, "Niphad-4 showed an exceptionally high baking quality. In fact it turned out to be one of the very best wheats handled by us so far. By yielding a shapely loaf of bread with an even crust of almost uniform break and shred, approaching Manitoba wheat in this respect, crumb of white colour, soft, resilient texture, silky to touch, an even 'grain' with rather elongated pores having thin cell walls, it scored as high as 79·7 baking marks. It also showed the highest oven-spring of 2·0 cm."

Niphad-4 also yielded best *chapatees*. Its *chapatees* were sweetish in test, softest and most pliable and were highest in fresh weight. They were, however, tough and greyish in colour.

The pedigree of Niphad-4 is as follows:—

Khapli (*T. dioccocum*, var. *Ajar*, Perc.) × Baxi (Natural cross) (*T. durum*, var. *melanopus*, Körn.)

Kala-Khapli-568 (*T. dioccocum*, var. *Kala-Khapli*) × Motia (Bansi-168) (*T. durum*, var. *hordeiforme*, Körn.)

Bansipli-809 (*T. durum*, var. *melanopus*, Körn.) × Pusa-4 (*T. vulgare*, var. *leucospermum*, Körn.)

Niphad-4 (*T. vulgare*, var. *pseudomeridionale*, Flaksb.)

The new wheat is now being multiplied for spread in the irrigated tracts of the Bombay Province.

Cereal Breeding Station,
Kundewadi, Niphad,
(H.Q. College of Agriculture,
Poona 5), B. S. KADAM.
March 14, 1944.

1. Ramdhan Singh, "Progress Report of the Scheme for Wheat Milling and Baking Tests for the Year ending June, 1943", I.C.A.R. and Department of Agriculture, Punjab, 1943. 2. Kadam, B. S., "Genetics of the Bansi Wheat of the Bombay Deccan and a Synthetic Kapli, Part I," *Proc. Indian Academy of Sciences*, 1936, **4**, No. 5, 357–69.

VERNALIZATION OF JUTE

THE effect of pre-sowing treatment on drought-resistance and yield in paddy by Parija[1] and on anthesis in wheat by Chinoy[2] have been reported. In the present communication the effect of pre-sowing treatment (alternate moistening and drying) and post-sowing light treatment on drought-resistance and earliness of flowering respectively on two species of jute—*Corchorus capsularis* (D. 154) and *C. olitorius* (Chinsura green) are reported. The seeds were allowed to swell in water for six hours and then gradually dried in dark at a tempe-

rature of 30° C. This alternate moistening and drying was continued and repeated for ten days. Every day the seeds were allowed to absorb water for three hours and then dried. This sort of prolonged treatment was made possible by means of the vernalization apparatus described before.[3] The treated seeds were sown in tubs as well as in replicated plots against control seeds (untreated but soaked overnight in water). The drought-resistance capacity of the seedlings were tested on the basis of wilting of the leaves and growing tips.

TABLE I

Period of drought in days	% Moisture of the soil	% of seddlings wilted in			
		C. capsularis		*C. olitorius*	
		Treated	Untreated	Treated	Untreated
	From 30%				
9	6·8%	15·2%	45·0%	28·2%	63·0%
12	5·3%	20·4%	67·8%	45·3%	85·1%
Percentage recovery after 5 hrs. on watering		89·6%	42·3%	52·6%	20·2%

TABLE II

Photoperiods*	Long days (20 hours)	Short days (8 hours)	Control (10–12 in.)
C. capsularis	120 days	69 days	116 days
C. olitorius	128 ,,	64 ,,	121 ,,
Difference from control in—			
C. capsularis	4 days (late)	47 days (early)	..
C. olitorius	7 ,, ,,	57 ,, ,,	..

There was no difference in percentage germination as a result of treatment. The treated seeds sprouted earlier and the seedlings showed an increased growth in height than the untreated seedlings of the same age. The seedlings were allowed to grow under normal conditions for a week and then were subjected to drought conditions. The moisture content of the soil in the tubs were brought to the same level of 30 per cent. of the soil. Then no water was given for a period of twelve days. The percentage of wilting of the seedlings in different treatments are given in Table I.

It was thus found that under the same conditions of drought, a larger percentage of untreated seedlings showed wilting than the treated ones and on watering the tubs again the percentage of recovery was also greater in the treated seedlings. The response to treatment also varied in the two species; *C. capsularis* showing greater resistance to drought than *C. olitarius*.

A similar method of pre-sowing treatment also brought about an earliness in flowering which was found to be on the average 6.0 days in plants grown under normal conditions. A significant earliness was, however, caused by regulating the post-sowing photoperiods as shown in Table II.

The post-sowing light treatment of short days was effective in bringing a significant earliness of flowering as observed by Sen Gupta and Sen,[4] but the long days were either not effective or showed a tendency towards retardation of flowering. The detailed results will be published elsewhere.

Bose Institute,
Calcutta,   B. K. KAR.
February 14, 1944.

* The different light periods were given to the seedlings at the age of 35 days and continued for a period of 17 days. The rest of the life-cycle was passed under normal day and night conditions.

1. Parija, *Curr. Sci.*, 1943, **3**, 80. 2. Chinoy, *Ibid.*, 1942, **10**, 400. 3. Kar, *Trans. Bose Inst.*, 1942–43, p. 105. 4. Sen Gupta and Sen, *Proc. 31st Ind. Sci. Cong.*, 1944, p. 89.

NOTE ON LUMINESCENCE IN SOME ALLAHABAD EARTHWORMS

THE cœlomic fluid of each Rangoon species of *Eutyphœus*, and also that of the single species of *Lampito*, glows with a more or less brilliant luminescence, when ejected through the dorsal pores[1] into a dilute solution of ammonia (Gates, 1925).

The cœlomic fluid of three species of *Eutyphœus* present in Allahabad, *E. incommodus* (Beddard, 1901), *nicholsoni* (Beddard, 1901), *waltoni* (Michaelsen, 1907), also glows in the

ammonia solution. The Rangoon species of *Eutyphœus*, like *nicholsoni* and *waltoni*, are metandric, but *incommodus* is holandric. As luminescence has been found in both sections of the genus, in each species that has been tested, the photogenic ability may now perhaps be expected to characterize the whole genus.

Specimens of *Ramiella nainiana* Gates (in press) give off, in the ammonia solution, a sticky slime which also luminesces, the glow brighter than that of *Lampito mauritii* Kinberg (1867), but not as bright as that of the Allahabad species of *Eutyphœus*.

One other species of *Ramiella*, a rather small one (*cultrifera* Stephenson, 1931), is found in Allahabad. Worms of this species, however, have produced no luminescence in any of several trials. *Octohætoides ferrnori* (Michaelsen, 1907), like the Rangoon species of the same genus, also appears to have no photogenic ability.

Ewing College,
Allahabad,
May 2, 1944.
G. E. GATES.

1. Gates, G. E., "Note on Luminescence in the Earthworms of Rangoon," *Recs. Indian Mus.*, 1925, 27.

ON THE LARVAL CERIANTHARIA FROM THE MADRAS PLANKTON

Isodactylactis tardiva, *I. discors*, *I. præcox* (Senna[1]), *Anactinia pelagica* (Annandale,[2] Menon[3]), *Arachnactis indica* (Menon,[4] Panikkar[5]) and *Apiactis bengalensis* (Panikkar[6]) are the larval Ceriantharia known from the Bay of Bengal. Madras plankton is fairly rich in these larvæ and all the genera mentioned except *Isodactylactis* are represented. In addition to these genera, the genus *Isarachnactis*, so far recorded only from the Mediterranean Sea (Carlgren[7]) and the Arabian Sea (Panikkar[8]) is represented in the Madras plankton by a rare and unidentified species. Further, an extremely rare, small, tentacleless larval Ceriantharia, probably belonging to the genus *Anactinia*, occurs in the plankton collections along with *A. pelagica*. These pelagic larvæ appear in fair numbers generally during the colder months of the year.

The first larval Ceriantharia, *Arachnactis albida*, was discovered in 1846 by Sars[9] and the first adult, *Cerianthus membranaceus*, in 1784 by Spallanzani.[10] Since then, about fifty larval Ceriantharia and about an equal number of adults have been discovered. Surprisingly none of these larval forms have been correlated with the adult forms by the actual study of the metamorphosis and growth of the larvæ into their respective adults.

At the suggestion of Professor R. Gopala Aiyar such a correlation of the larval forms of Ceriantharia occurring on the Madras Coast with their adults was undertaken and has proved very successful. The larvæ obtained from the townet collections on being transferred to the Laboratory aquarium tanks begin metamorphosis in a couple of days, if a suitable substratum of sand or of sand and mud is given. Metamorphosis may be said to have commenced when the floating larvæ sink to the bottom and begin to burrow into the substratum which they do by means of the aboral end.

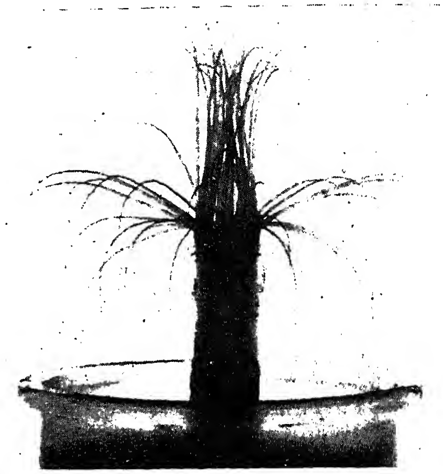


FIG. 1. Adult of *Apiactis bengalensis*, 348 days old with 65 marginal tentacles. $\times\ ^{2}/_{5}$.

With the growth of the larvæ, the colouration characteristic of the adults becomes more and more discernible. A regular change of clean sea water is essential. Raw flesh of *Emerita* and *Acetes* was given as routine food and the specimens flourished very well under these conditions.

There is considerable variation in the tubes of the different genera. *Apiactis* burrows into the sand and constructs a tube for life which

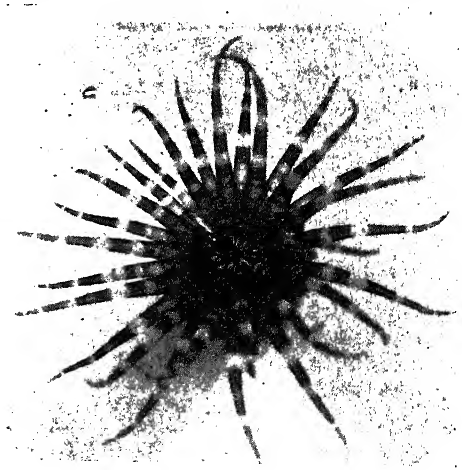


FIG. 2. Adult of *Isarachnactis* sp., 595 days old with 29 marginal tentacles. $\times 1^{1}/_{2}$

enlarges with the growth of the animal. Part of this tube projects above the level of the substratum. The white and jelly-like tube is composed entirely of nematocysts and mucus. No sand particles are used in the construction of the tube which is inseparably associated with the animal. The tube

of *Isarachnactis* is irregular, branched and meandering. The animal deserts the tube occasionally to construct another. The tube is composed mainly of sand particles held together by nematocysts and mucus. *Anactinia* is

FIG. 3. Adult of *Anactinia pelagica*, 186 days old with 34 marginal tentacles. × 2/1.

not a regular burrower but constructs round its body a thin, loose and transparent tube formed of nematocysts and mucus. This form has the peculiar habit of deserting its tube at frequent intervals.

All the larval Ceriantharia collected from the Madras plankton have been successfully reared into healthy adults. The photographs of some of the adults of the larvæ reared in the Laboratory and taken in the living condition are

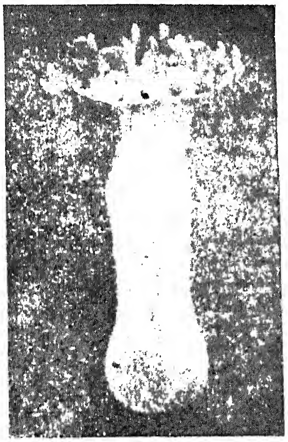


FIG. 4. Adult of *Anactinia* sp., 68 days old with 26 marginal tentacles. × 1.

reproduced here. The age given in each case is calculated from the commencement of the metamorphosis as indicated by the settling down of the larva.

The detailed morphological and taxonomical characters of the larvæ and their respective adults, together with the structural changes during metamorphosis will be given elsewhere.

Zoological Research Lab.,
University of Madras, R. VELAPPAN NAIR.
April 10, 1944.

1. Senna, A., Rarcolte Planctoniche fatte dalla R. Nave 'Liguria', 1907, **1**, 3. 2. Annandale, N., *Rec. Ind., Mus., Calcutta*, 1909, 3. 3. Menon, K. R., *Ibid.*, 1914, 10. 4. Menon, K. S., *Ibid.*, 1931, 33. 5. Panikkar, N. K., unpublished. 6. —, *Zool. Anz.*, 1936, 115. 7. Carlgren, O., *Wiss. Erg. Deutsch. Tiefsee-Exp.*, 1924, **19**, 8. 8. Panikkar, N. K.. *Curr. Sci.*, 1938, **7**, 6. 9. Sars, M., *Funa littoralis Norvegiæ*, 1846, 1. 10. Spallanzani, L., *Mem. Soc. Ital. di Verona*, 1784, 2.

PREVENTION OF DAMAGE TO STORED POTATOES BY THE POTATO TUBER MOTH*

THE potato tuber moth is a most destructive pest of stored potatoes in India and elsewhere: it may destroy cent per cent. of the potato seed stored in the hills from the spring crop for sowing in the plains in September-October. Research on finding an effective control has been in progress since 1907, but so far no satisfactory solution of the problem has been found. The urgent and great need for saving stored potatoes from destruction by this pest particularly during the war, makes it imperative to discover, without any further loss of time, preventive measures against it, well within means and reach of the cultivator. With this object in view I took up work on this pest last year and the resuts which I have obtained in the first year of my work are so striking and encouraging that I have thought it desirable to place them before the scientific public in India with the hope of receiving helpful criticism and stimulating further study of the problem. In these investigations the main consideration is to utilise articles which are commonly found in the localities in which potatoes are stored.

In the Punjab seed potatoes are generally stored during July—second week of September in the Kangra Valley. Therefore, trials with various covering articles were carried out in the Valley at Palampur (Punjab). 43 maunds and 8 seers of mature and sound potatoes were used in these experiments.

The total quantity of potatoes was divided into 56 small heaps, 32 of which contained 24 seers of potatoes each, while the remaining 24 heaps contained 40 seers each. 48 Heaps (24 of 24 seers each and 24 of 40 seers each) were placed in as many compartments in two wooden racks A and B respectively, while the remaining 8 heaps (each of 24 seers) were placed on a pacca floor. Each shelf in the racks was made of strips of wood nailed together and covered with bamboo matting. Potatoes stored in the racks and those on the

floor were kept in a room which was not insect-proof; each of the 24 seer heaps were 3 in. deep, while the 40 seer heaps were 5 in. deep. Out of each group of 8 heaps one was kept as control and the remaining seven were covered with a one-inch thick layer of dry chopped lantana, saw dust, "bhusa", dry local grass, dry soapnut leaves, sand and pine needles respectively, selection for each treatment being made by randomization. There were thus three replications on each rack and one on the floor. The heaps in the racks were covered on top while those on the floor were covered on the sides also. After covering the healthy potatoes with these articles, 8 maunds of tubers, heavily infested with the pest, were uniformly distributed in the room.

During storage, in addition to the potato tuber moth, potatoes are destroyed by a fungus disease which causes rotting. Therefore, for judging the efficacy of the various covering articles, loss due to the pest and to the fungus disease was taken into consideration and the results obtained are tabulated below:—

Table showing effect of covering potatoes in storage with different articles

Treatment	Average % of loss in Rack A due to		Average % of loss in Rack B due to		Average % of loss on pacca floor due to	
	Potato tuber moth†	Rotting	Potato tuber moth†	Rotting	Potato tuber moth†	Rotting
Control	50·6	6·1	56·1	4·2	73·1	4·4
Lantana	2·6	3·1	1·7	2·1	8·0	3·1
Saw dust	2·1	3·6	6·3	2·5	3·1	4·6
Bhusa	1·8	9·9	3·1	2·5	6·2	1·5
Grass	2·7	2·6	3·2	3·4	10·4	2·9
Soap nut leaves	4·7	2·9	2·5	2·1	10·6	5·4
Sand	5·3	5·7	2·4	3·1	—	4·8
Pine needles	4·1	3·5	7·3	3·5	29·1	6·2

It will be seen from the above table that the percentage of loss due to insect attack as well as rotting was higher when potatoes were stored on the floor than when they were stored on racks. Saw dust, lantana, local grass, and "bhusa" gave good results. These experiments are being continued.

Entomologist to
Government, Punjab,
Lyallpur, KHAN A. RAHMAN.
April 11, 1944.

* *Phthorimæa operculella* Zell. *Gelechidæ lepidoptera.*
† Includes all potatoes showing moth damage.

DO THE ARMY WORM MOTHS IN INDIA HAVE PHASES?

VERY recently, Faure (1943*b*) has published an important paper, which deserves to be widely known in India, on phase variation in the S. African army worm moth, *Laphygma exempta* (Walker). It exhibits *solitaria* (non-swarming) and *gregaria* (swarming) phases. Faure has conclusively demonstrated from laboratory experiments that larvæ reared crowded develop a velvety black or *gregaria* coloration, while those reared in isolation acquire a green or *solitaria* colour. The *gregaria* larvæ are far more active than the *solitaria*. In addition, Faure has brought forward evidence to show that the moth occurs as a pest in certain years, but is not to be seen in others. Normally it breeds permanently only in certain, as yet unknown, outbreak centres from which it migrates to considerable distances in swarming years. Thus, unless the permanent homes of the *solitarias* are discovered through continued search, the biology of the moth cannot be correctly understood and the control cannot be very effective. The parallel with locusts is striking, with this difference that so far the adult moth of the army worm have not been shown to have any apparent morphological phase differences.

This is the first clear instance of well-developed phase variation in an insect other than locusts and grasshoppers where it is now well known since the discovery of Uvarov (1921). Zoologists must now look for it in other animals, wherever a tendency to natural gregariousness occurs.

But to Indian economic entomologists the chief importance of Faure's discovery lies in the fact that the army worm is one of the serious pests of rice, and it is important to know whether, as in S. Africa, it has phases. For, if the phases are present, the permanent homes have to be discovered. The position is further complicated by the fact that Faure has thrown some doubt on the identity of the Indian army worm moth. He writes (1943*b*, p. 1): "..... *Spodoptera mauritia* (Boisd.) appears to be the important army worm in Ceylon and in India, as well as in certain other parts of the continent of Asia, but outbreak of this species have also been reported from Australia, Java, and the Philippines. Both *L. exempta* and *S. mauritia* are recorded as occurring in Africa and in India (Janse, 1937-39); in Africa only *L. exempta* is known as an army worm and in India only *S. mauritia* appears to attain outbreak numbers. Since Swezey (1938) has stated that the nutgrass army worm was for many years known as *Spodoptera mauritia* Boisd., but it has now been identified as *Laphygma exempta* Walk., in Hawaii, one wonders whether the army worms of Africa and India are not perhaps one and the same species.

"The question of the correct identification of the army worms of Africa and India is not merely a matter of academic importance. If it is correct that both species referred to in the preceding paragraph are common in both regions, and that only one of them produces outbreaks in each region, it might be worthwhile to make a thorough study of the two species, both in India and in Africa. It is conceivable that parasites may play a role of importance in preventing outbreaks of *S. mauritia* in Africa, or of *L. exempta* in India, and in this event the importation of parasites into

one or both of these regions might be worth attempting."

Faure (1943*a*) had shown earlier the occurrence of comparatively weakly developed phases in the lesser army worm *Laphygma exigna* (Hubn.). He has also shown (1943*b*) that the lawn caterpillar, *Spodoptera abyssinia* Guen. exhibits what is probably an incipient development of phases.

This note has been written with the purpose of bringing Faure's discovery to the notice of Indian entomologists. Phase studies in India should be conducted simultaneously on *L. exempta* and *S. mauritia*. Ayyar (1940, p. 152) states that in the latter the larvæ, when full grown, are dark to pale green, though there is a good deal of variation in colour. This may possibly be due, in part, to phase differences. The life-history of *L. exempta* in S. Africa has been given by Hattingh (1941).

Zoological Survey of
India, Kaiser Castle,
Benares Cantonment, M. L. Roonwal.
April 11, 1944.

1. Ayyar, T. V. R., *Handbook of Economic Entomology for South India*, 1940, p. 528, Madras. 2. Faure, J. C.. *Emg. in S. Afr.*, 1943*a*, **18**, 69–78. 3. —, *Sci. Bull. Dep. Agric. and For. Un., S. Afr.*, No. 234 (Nov. 1943), **1943*b***, p. 17, pl. 1. 4. Hattingh, C. C., *Ibid.*, No. 217, **1941**, p. 8, pls. 2. 5. Janse, A. J. T., *The Moths of South Africa* (1940), Pretoria, 1937–39, p. 435, pls. 46. 6. Swezey, O. H., *Proc. Hawaii Ent. Soc.*, 1938, **10** (1), 75–6. 7. Uvarov, B. P., *Bull. Ent. Res.*, **1921**, **12** (2), 135–63.

MICROBRACON BREVICORNIS, W. IN THE BIOLOGICAL CONTROL OF THE LAB-LAB POD-BORER

Microbracon brevicornis W. (Braconidæ), the ectophagous larval parasite of *Corcyra cephalonica* St., the common moth-pest of stored rice, jowar and flour, has recently been successfully tested in the laboratory and out in the field, against *Adisura atkinsoni*, the common pod-borer caterpillar of Lab-lab. In most of the several cultures set up in the laboratory with particular instars of laboratory-bred pod-borers and treated with freshly emerged individuals of *Microbracon brevicornis* W., the host was readily stung and eggs were deposited by the females; the grubs hatching out from the eggs fed on the caterpillar-hosts and pupated in due course and adult parasites subsequently emerged out. Not only naked and free host caterpillars but also others inside Lab-lab pods in the different cultures were freely parasitised, the female parasites even penetrating easily, through punctures, inside the pods.

Similar observations were made, also, in the case of cloth cages enclosing infested pod-bearing branches of Lab-lab, and others fixed in the soil enclosing whole bushes into which suitable numbers of parasites were introduced.

Bulk releases of *Microbracon brevicornis* W., in selected plots (with proper controls) of borer-infested Lab-lab, in the field were also made at the Hebbal Farm. Definite numbers of pods picked out at random, at definite intervals in the treated and control plots, were examined in the laboratory and clear and abundant signs of parasitisation were found; other lots of pods picked in the field were kept by, from which adult parasites were, in due course, recovered in fair numbers.

The natural field parasites, namely, *Microbracon hebetor*, of the Lab-lab pod-borer larvæ was, of course, also recovered from the pods picked out from the plots. It is clearly evident that both the natural parasite of the pod-borer larvæ and the introduced or released parasite, *Microbracon brevicornis* W., select out the same hosts separately in the same plot for parasitisation.

Entomological Laboratory,
Department of Agriculture,
Bangalore, B. Krishnamurti.
March 12, 1944. M. Appanna.

CLASSIFICATION OF MANGOES

It is estimated that there are now over 500 known and named varieties of mangoes in India. This number, however, is not based on a scientific system of classification, because it has been usual to classify them on the shape and other characters of the fruit. An attempt is now made to determine whether morphological characters such as tree habit, branching and foliage would be helpful in evolving a satisfactory classification.

The mango wealth of India may be considered under two groups: (*a*) Seedling trees, and (*b*) grafted trees. In spite of their number and utility, the latter are merely horticultural varieties, having their origin in chance seedling trees, the genetic purity of which is not established. It must be recognised that as a result of grafting, features like low branching and tree vigor are likely to be influenced by the root-stock and hence a full and natural description of any variety may only be obtained from the original seedling tree. In view of this, only the naturally growing seedling trees ought to be considered as a basis of classification.

In a study of 25 grafted mango varieties and 107 seedling trees grown in the Baroda State, it is observed that:—

(1) The branching is close and erect, semi-open or open, depending upon the angle at which the main branches are held in relation to the main trunk.

(2) The foliage is sparse, medium dense or dense; and light green, green or dark green in colour.

(3) The sizes and shapes of leaves vary widely. Leaves borne at the ends of shoots have a broader base than those at the lower nodes. Waviness of the margin, folding of the sides of the lamina, texture and aroma are some other factors which vary considerably. The anthocyanin displayed by young immature leaves is an interesting character. Scaly leaves of opening buds and those towards the stem apices are generally light green in colour, irrespective of the shade they exhibit as they mature. The light green gradually changes into the characteristic green of fully grown leaves through various intermediate shades.

The intensity of and the changes in the shades observed at various stages of growth from the scaly leaves of opening buds to the fully mature leaves are characteristic of individual trees as also of the grafted varieties.

(4) The size of the inflorescence and the density of flowers also vary.

This study appears to indicate that morphological characters may serve as criteria in building up a system of classification of the mangoes.

Baroda, S. S. BHAT.
May 22, 1944.

THE MASS-BREEDING OF THE BRACONID, *MICROBRACON HEBETOR* SAY, IN INDIA

KRISHNAMURTI AND SESHAGIRI RAO,[1] in a recent communication to *Current Science*, under the heading "A Preliminary Note on the Breeding of the Beneficial Ectophagous Larval Parasite (Braconidæ) on a laboratory host", claim to have bred *Microbracon hebetor* in some numbers on a laboratory host other than its natural host, for the first time in India.

M. hebetor was discovered in Namkum (Bihar) during 1934 and since then it has been bred in large numbers on several laboratory hosts, for utilisation as introduced parasite against the lac predators, *Holcocera pulverea* and *Eublemma amabilis*. The life-history and habits of the parasite have been worked out in some detail and a method has been developed to breed it in large numbers in the laboratory.[2] This braconid has been reared on several alternative hosts.[3] The following table gives a summary of breeding of *M. hebetor* during 1942-43 on some laboratory hosts, which have been found most suitable to breed it.

Name of host larva	Average percentage parasitisation	Number of adults bred per host larva
Holococera pulverea	21·9	1·01
Ephestia cautella	40·5	1·7
Platyedra gossypiella	40·10	2·4
Corcyra cephalonica	26·09	0·93

M. hebetor is an extremely polyphagous species and recorded from different parts of the world. In India, its natural host differs from place to place; its natural host in Chotanagpur (Bihar) appears to be *Ephestia cautella*, a destructive borer pest of flowers and seeds of Mohua (*Bassia latifolia* Roxb.), in Delhi it is found parasitising the caterpillars of *Antegastra cataunalis* Dup., and *Laphygma* sp., and in S. India the larvæ of *Corcyra cephalonica* and *Adisura atkinsoni*.

In the field of mass breeding of larval parasites on hosts other than the natural host it may be stated that we are getting interesting results in breeding *Microbracon greeni* Ashm., the indigenous and specific parasite of *Eublemma amabilis* and they will be published in due course.

P. S. NEGI.
T. V. VENKATRAMAN.
K. C. CHATTERJEE.
Department of Entomology,
Indian Lac Research Institute,
Namkum, Ranchi,
April 6, 1944.

1. Krishnamurthi, B., and Seshagiri Rao, D., *Curr. Sci.*, 1944, **13**, No. **3**, 81–82. 2. Glover, P. M., and Chatterjee, K. C., *Proc. Ind. Acad. Sci.*, 1936, **3**, No. 3, 195–211. 3. *Annual Reports of the Indian Lac Research Institute*, *Namkum*, 1935–1943.

WHILE thanking Messrs. P. S. Negi, T. V. Venkatraman and K. C. Chatterjee, for drawing our attention to their work on *Microbracon hebetor*, the results of which, published in the *Annual Reports of the Indian Lac Research Institute*, Namkum, were not accessible to us, we wish to point out, that the results obtained by us, here, independently, have special reference to certain olfactory preferences of the parasite, in an artificially prepared medium having (the laboratory Host) *Corcyra cephalonica* in it. This host is not an alternative normal host of the parasite at all, in any sense, in Mysore.

In the particular kind of medium in which this laboratory host was offered in three lots to the parasite, the following percentages of parasitisation have been obtained.

Lot No.	P.C. of parasitisation	No of adults bred per host
1	66·6	5·5
2	8·3	3·0
3	20·0	4·0
Average ..	25·0	4·5

Entomological Laboratory,
Dept. of Agriculture, B. KRISHNAMURTI.
Bangalore, D. SESHAGIRI RAO.
May 1, 1944.

REVIEWS

Modern Synthetic Rubbers. By Harry Barron. (Messrs. Chapman and Hall Ltd., London), 1943. Pp. 355. Price 28*s.* net.

The reviewer had the privilege of reading the first edition and a review by him appeared in the *Current Science* a short while ago. The importance of the publication and the interest which attaches to synthetic rubbers are amply borne out by the fact that a second edition has come out within a year of the publication of the first edition. The second edition is singularly free from some of the errors which crept in owing to war-time publication difficulties in the first. The subject-matter is arranged in a manner similar to that in the first edition. The contents are mainly divided in three parts, namely, (1) General considerations, (2) Chemical and physical background of synthetic elastic materials, and (3) Technology of synthetic elastic materials. These parts are subdivided into a number of principal and minor subjects. Amongst the principal subjects treated in the book may be mentioned the following: Natural rubber and synthetic rubber-like materials, Economics of synthetic elastic materials, Terminology, Historical brackground of synthetic elastics, Chemical behaviour and structure of natural rubber, Raw materials—Alcohol and Acetylene, Raw materials—Petroleum, Polymerization, Copolymerization, Emulsion polymerization, Elastomers—S.K.B. and Buna rubbers, Elastomers—Perbunan, Hycar i.r. Chemigum, Elastomers—Neoprene, Elastenes—Polyisobutylene, Butyl rubber, Thioplasts, Ethenoid elastics, Ethyl cellulose, some additional comparative properties of elastics.

The book is a storehouse of information on this interesting subject. The scientific work on synthetic rubber-like subjects is being developed so rapidly throughout the world that a new book should be in demand next year. As a matter of fact some of the applications of plastics and rubber-like substances will be described only after the war. The book is scientifically planned. It is accurate and although the bias of the enthusiast is still there, such bias is welcome as nothing new ever gets developed unless its promoters have a missionary zeal for their subject. The author deserves the sincerest thanks of workers in this field for a book which is soon to be most widely read.

S. S. B.

A Text-Book of Sound for B.Sc. Students. By R. N. Ghosh, D.Sc., F.N.I., and R. N. Rai, M.Sc. (The Indian Press, Ltd., Allahabad), 1943. Pp. 313. Price Rs. 7-8-0.

The first edition of this book was reviewed in these columns three years ago and the fact that in such a brief period a second edition has to make its appearance shows the approval and wide acceptance it has received from those for whom it is specifically intended.

The subject of Sound has so far received but stepmotherly treatment in the curricula in physics, pass or honours, of our universities. Students consider it as a necessary evil to be got through when not got around. The interest in the study of acoustics, however, was given a mighty impetus by the technology of electrical recording and reproduction of sound and radio broadcasting. In the evolution of finer acoustical instruments and the development of measuring techniques lies the origin of the new branch appropriately called electro-acoustics, with its manifold contributions in solving the problems of the architectural and physiological acoustics. These developments have yet to be reflected in the reorganisation of our university curricula in acoustics. Be it as it may, the task of the authors must indeed be a difficult one in catering to the needs of the present-day student and at the same time acquaint him with the latest developments—all in one volume.

In addition to an elementary treatment of the basic kinematical principles, dynamical theory, plane waves, standing waves, etc., and musical acoustics, the authors have given brief accounts of their technological applications. A welcome feature is a whole chapter devoted to architectural acoustics—and sound absorption problems. Considerable information is given on the propagation of sound in atmosphere, wind effects, etc., with application to fog-signalling and sound location. A short description of ultrasonics is also included. A general idea of motion picture sound recording and reproduction is to be found in the last few pages of the text. Four appendices have been added with a hope that "the additions of the electrical analogies to mechanical systems will bring the book up-to-date."

Chief criticism is that due probably to a large number of subjects dealt with in the book lapses do occur at some places in the unity and precision of the treatment of the subject-matter. "The authors have given up the traditional method of treatment". However, the reviewer feels that a more fortunate choice could have been made in the chapter titles.

On page 227, article 177 (*b*), the formula for $1/t_2$ should be

$$\frac{1}{t_2} = \frac{\Sigma s\alpha + s_2\alpha_2 - s_2 \dfrac{\Sigma s\alpha}{\Sigma s}}{\cdot 05\mathrm{V}}$$

The formula for $\bar{\alpha}$ on page 228 should be

$$\bar{\alpha} = \frac{4\mathrm{V}}{c\mathrm{S}'} \log_e \frac{\mathrm{P}_2}{\mathrm{P}_1} \cdot \frac{1}{t_2 - t_1}.$$

On page 255, article 203, the difference between the Audio-frequency oscillator and the Beat-freouency oscillator should have been pointed out to avoid confusion.

The spark pictures given in Fig. 162 on page 223 relate to the Royal Institution lecture

theatre and not to any "gallary of the National Physical Laboratory, London".

These are few oversights in this book, which the reviewer feels obliged to point out. It is hoped that the next edition will find them missing.

The authors are to be complimented for their efforts in making the subject interesting and by offering enough attractions for the 'sound-shy' physics students of our universities. The book will be enthusiastically received.

N. B. BHATT.

Heavy Industries in British India. (All-India Manufacturers' Organization, Bombay, Monograph No. 5), March 1944. Pp. 30.

"The industrial advance of a country is usually judged by the progress of its heavy industries. If at least two new heavy industries are started in every province within a year or two after the termination of the war, all the essential key industries, including factories for the manufacture of machinery, machine tools and plant, will have been established, and the country practically made industrially self-supporting." Choice can be made from the list given on page 2 or other key industries allied to them. The present brochure gives a connected view of the existing state of industrial advance both in individual provinces and in the country as a whole. If industrial advance can be estimated on the basis of amount of income-tax paid, then of the eleven Indian provinces, Bombay leads with Rs. 6·97 crores, with Bengal a close second with Rs. 6·67 crores while Madras is a distant third with Rs. 2·17 crores (figures for 1941-42). A better criterion will, however, be on the basis of the development of fundamental industries like those connected with production of iron and steel and other basic materials of construction, scientific and industrial equipments including industrial machinery and tools, and heavy and fine chemicals.

Industrial leaders and businessmen in the provinces are requested to co-operate with the All-India Manufacturers' Organisation by furnishing it with reliable information on the present state of industries in their respective provinces including particulars of mineral deposits and other sources available for future development.

M. A. G.

Supplement to Studies of the Identification of Timbers. By Alexander L. Howard. (Macmillan and Co., Ltd., London), 1943. Price 5*sh*.

The well-known wood anatomist, Dr. A. L. Howard, has presented in this small pamphlet 153 microphotographs of wood specimens belonging to diverse natural orders. This no doubt is a publication for which there has been a long-felt need. The value of the pamphlet would have been very much enhanced if scientific names had been cited for the good many microphotographs presented here to the reader only by their local or vernacular names. The sections from which the microphotographs, particularly of Lignum-Vitæ (page 5), Papaw (page 12) and Huon Pine (page 15) are taken, do not appear to have been prepared with due care and dexterity. Some of the microphotographs, especially of Muskwood (page 9) and Pao carga (page 12), are so badly reproduced that it is difficult to differentiate between the various tissue systems of the wood. More representative portions of the woods of *Michelia nilagirica* (page 8), and *Listœa zeylanica* (page 5) should have been selected for publication. The microphotograph of Silky Oak (page 17), under which are printed the three names,—*Grevillea robusta, Orites excelsa* and *Cardwellia sublimis*, is very misleading; this microphotograph does not bear any resemblance to *Grevillia robusta* in the character of grouping of vessels and distribution of parenchyma, both of which are important diagnostic features of the species. Fortunately there is an errata slip pasted on the first page, calling attention to certain microphotographs which have been inserted upside down. To this list should be added No. 767 on page 14. The microphotograph No. 922, mentioned on this slip is not traceable in the pages that follow. With better care bestowed as to accuracy in detail, the publication would undoubtedly have been a very valuable companion to various classes of students of timber structure such as Forest Officers, Wood Technologists and Timber Dealers.

B.G.L.S.

Post-War Reconstruction of Libraries in India—A Scheme. By S. R. Ranganathan. (The Punjab Library Association, Lahore), 1944. Pp. 36. Price Re. 1.

The enterprising Editor of the *Modern Librarian*, Lahore, has kept the library profession abreast of the times in post-war problems by inaugurating a "Library in India Series" with the publication of the above booklet from the pen of a well-known Librarian. The first few pages set forth a six-point plan for libraries in reconstruction and the rest deal with the financing and functioning of the scheme. One of the principal proposals in the scheme is the establishment of a Department of Libraries in each province and at the Centre, with a few checks and controls of bigger libraries on smaller libraries. The important question of the organization or mobilization of science libraries, however, has not received anything more than a passing remark. The problem confronting the libraries is a particular phase of the greater national one, namely, the planning of education of the millions of men and women in the country and it can scarcely be gainsaid that the scheme contemplates a new order in the Indian library world. It is a document well worth study in any programme of educational reconstruction.

G. T. K.

SCIENCE NOTES AND NEWS

At the first meeting of the Industrial Research Planning Committee held on Monday, the 20th March 1944, at 2-30 p.m., and Tuesday, the 21st March and Wednesday, the 22nd March 1944, in the Board Room of the Bombay House, 24, Bruce Street, Bombay, the following resolutions were adopted:—

(1) "This Committee is of opinion that a comprehensive national register of all the persons qualified to conduct scientific and industrial research is essential and that the task of initial preparation and maintenance of this register might be delegated to an unofficial agency like the National Institute of Sciences of India. For the purpose of preparation of this register the minimum qualification must be the B.Sc., B.E., or an equivalent degree in science or technology."

(2) "This Committee is of the opinion that a national register of persons actually engaged in scientific research should be prepared and kept up-to-date from time to time. This register should contain the names of those persons who after taking the University degree in science or its equivalent are engaged in research work in Universities, Research Institutions, Private Laboratories and Industry. The initial preparation of this register must be undertaken by this Committee itself. The subsequent maintenance of this register from time to time must be done by an unofficial agency like the National Institute of Sciences of India."

(3) "With a view to getting the names of research workers employed in industry a questionnaire should be sent to The Federation of Indian Chambers of Commerce and Industry, The Associated Chambers and other Chambers of Commerce, All Directors of Industries, Universities, Defence Services, Government Departments."

The Committee decided to issue questionnaire with a view to elicit the completest information from Universities, Research Institutions, Industries, etc., with regard to the existing facilities for research available by way of research personnel equipment and library. Two sets of questionnaire were finally prepared and it was decided to address these questionnaire to Universities, Research Institutions and to such of those industries who have their research establishments and Chambers of Commerce, Directors of Industries of Provinces and States and the various Government Departments.

National Register of Scientists (under compilation by the Industrial Research Planning Committee under the auspices of the Council of Scientific and Industrial Research, Government of India).—All those persons who are actually engaged in scientific research are entitled to have their names recorded in the above register and are requested to fill in the prescribed form which can be had from the Secretary, Industrial Research Planning Committee, University Buildings, Delhi.

A. N. David, Civil Lines, Ajmer, reports:—

On 22-4-1944, at about 4-30 a.m., near Sauganer (State Jaipur, Rajputana), a glowing meteor, of the size of a big football, shot in north-to-south direction, almost parallel to the eastern horizon, and appeared to explode at ground-level, for it sent out red sparks and flashes of flame all round, clearly visible to the passengers in the U.P. Mail Train, but no noise could be heard.

On 2-5-1944, at about 8-30 p.m., at Ajmer (Rajputana), while it was yet twilight, a meteor, bluish in colour, and of the size of a small football, shot vertically down the western horizon, from an angle of 45° or so, leaving a livid streak of white light, which was straight at first, but gradually assumed an erratic shape (due apparently to the conflicting upper-air currents), but which remained quite immovable for about 20 minutes! It was prominently visible to the naked eye, a very unusual occurrence because of its long duration and length of track.

Harvard Announcement Card No. 680 contains a report on the success of the Mexican expedition relating to the total Solar Eclipse of January 25, 1944. The expedition, led by Dr. Joaquin Gallo, was stationed at Chicaly, Peru. The report follows:

Sky Clear, seeing good. Contrast between corona and sky light comparatively feeble, due perhaps to low altitude of the sun. Sky illumination intense in comparison with other eclipses observed by Gallo. All plates taken came out all right except one with the long focus camera. Developing of plates presented serious difficulties that were happily overcome. Seventy-five per cent. of observing programme was satisfactorily carried out. On first inspection no traces of polarization are apparent on polaroid plates. This is by no means a final result. Duration of totality was two minutes, forty seconds by actual count by Gallo against his previous computation of two minutes, forty-three seconds. Lima astronomers calculated two minutes, forty-seven seconds, and obtained from their observations two minutes and fifty seconds.—(From 'Astronomy News-Letter,' No. 16, of U.S.A.)

Reports have recently reached the United States of an important astronomical conference held in Moscow on September 14, 1943. In the issue of *Science*, dated February 4, 1944, Dr. Struve writes of an ambitious plan, presented at this conference for the development of a large southern astrophysical observatory. A copy of the *Moscow News* of September 11, 1943, made available to the C. D. A. L. by Dr. Roy K. Marshall, has further details about the conference.

The article in the *Moscow News* states that 9 of 19 Soviet observatories were "situated in territory temporarily occupied by the enemy". It is further noted that most of the equipment

and the library of the Pulkovo Observatory were removed to safer places before the observatory itself was destroyed by air and artillery bombardment. The Pulkovo staff is now carrying on work at Tashkent, Abastumani and Alma-Ata. The international latitude station at Kitab, Uzbekistan, is functioning regularly.

The article by Dr. Struve states that the Pulkovo Observatory will be re-established as a centre of positional work, together with the Engelhardt, Nikolaeff and Tashkent Observatories. An Astrophysical Observatory, with headquarters at Simferopol in the Crimea, and with three observing Stations, one in the Crimea at 2,000 metres, a solar station at 3,500 metres and a southern station, possibly in Africa. The equipment for the new observatory, for which plans are being drawn by Dr. Martinov, is to include one 120-inch reflector, two 80-inch reflectors, two 16-inch double astrographs, one 50-inch and one 30-inch Schmidt telescope, solar towers, a coronagraph and numerous other items. Plans are under way for the training of 60 or 70 astrophysicists to staff the new institution. Astronomers everywhere will be keenly interested in further news about these great plans for post-war astronomical research in the Soviet Union.

—(From 'Astronomy News-Letter,' No. 16, of U.S.A.

One of the most valuable substances yet discovered for the treatment of wounds has just gone successfully through its tests on the eve of the Second Front. These tests date back to the Desert War, writes a *Daily Telegraph* reporter.

Among the medical supplies captured by the Eighth Army from Rommel's retreating forces, he adds, were quantities of "Marfanil", a preparation in the same group as M and B. Three R.A.M.C. Officers described in *Lancet* the way in which actual battle casualties have responded to the new treatment. "Of the many substances we have tested for infected wounds," they say, "only Penicillin has given better results. And at present for technical reasons it may prove easier to produce Marfanil in much larger amounts than Penicillin."

Penicillin, they point out, will certainly not be available in quantities to treat all the wounded who will be in need of it.

Clinical use of Marfanil has shown that it is active in the presence of pus unlike most of the sulphonamide preparations. It prevents the growth of organisms in a wound which have resisted every other kind of antiseptic. There is almost no irritation and no destruction of tissue, while success in controlling infection hastens healing.

Altogether 70 per cent. of patients showed some improvement while 50 per cent. showed a marked improvement.—London, by cable.

The All-India Manufacturers' Organization have sent the following telegram to The Private Secretary to His Excellency the Viceroy: "In view of active work now progressing under Government of India Departments regarding Post-War Economic Reconstruction which Committee of the All-India Manufacturers' Organization has noted with satisfaction we urge in order to get complete benefit from these activities they should all be co-ordinated under a separate Member of Executive Council with his own Secretariat. We further urge that the appointment should go to an eminent Indian industrialist commanding complete confidence of Indian public."

The London University has recently conferred upon Dr. G. D. Bhalerao, Officer-in-charge, Veterinary Zoology Section, Imperial Veterinary Research Institute, Izatnagar, the degree of Doctor of Science for his valuable researches on Helminthology. Dr. Bhalerao is the first Indian to obtain this distinction.

Pawley's Scholarship of Rs. 16,500 has been awarded to Mr. J. P. Chawla, for study of Aeronautical Engineering at the Massachusetts Institute of Aeronautical Engineering, for a period of one year. This scholarship was endowed by Mr. W. D. Pawley, formerly Chairman, Hindustan Aircraft Corporation. Mr. Chawla has completed his training at the Aeronautical Engineering Department of the Indian Institute of Science, and is now employed in the Hindustan Aircraft Factory at Bangalore.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 92, Nos. 4657-4661.

"Journal of Agricultural Research," Vol. 67, Nos. 10-12.

"Agricultural Gazette of New South Wales," Vol. 55, Pts. 1-3.

"Indian Journal of Agricultural Science," Vol. 13, Pt. 4.

"Allahabad Farmer," Vol. 18, Nos. 1, 2.

"Biological Reviews," Vol. 19, No. 1.

"Annals of Biochemistry and Experimental Medicine," Vol. 3, Nos. 3-4.

BOOKS

Systematics and the Origin of Species. By Ernst Mayr. (Columbia University Press, 2960, Broadway, New York), 1942. Pp. xiv + 334. $4.00.

Photoperiodism in the Potato. By C. M. Driver and J. G. Hawkes. (Imperial Bureau of Plant Breeding and Genetics), Dec. 1943. Pp. 36. Price 2/6.

Optical Workshop Principles. By Col. Ch. Deve, translated by T. L. Tippell. (Robert Maclehose & Co., Ltd., The University Press, Glasgow), 1943. Pp. 306. Price 20*sh.*

Solvents . By Thos. H. Durrans. (Messrs. Chapman & Hall, 11, Henrietta St., W.C. 2), 1944. Pp. xii + 202. Price 17/6.

Wolf Children and Feral Man. By the Rev. J. A. L. Singh and Prof. Robert M. Zingg. (Harper & Brothers, 49, East, 33rd St., New York), Pp. 379. Price $4.00.

The Purification of Water Supplies. By George Brans by Williams. (Chapman & Hall, Ltd., 11, Henrietta St., W.C. 2, London), 1944. Pp. 95. Price 7*sh.* 6*d.*

530-44—The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

CURRENT SCIENCE

Vol. XIII] JUNE 1944 [No. 6

THE TEACHER AND RECONSTRUCTION

AMIDST the world-wide struggle which has continued to rage with all the ferocity of a modern war, plans for post-war reconstruction are being forged by all nations. Rehabilitation, currency, form of government, industrialisation, transport, markets, food production, health, employment and social security, have, each of them, been receiving their share of attention at the hands of the several expert committees set up for investigation and report. The problems of education, in its various aspects, the type of education to be imparted to the rising generation, education for enlightened world-citizenship, education for research and industry, education for character and culture, and education for peace, are being widely discussed by the public and the press. Leading educationists are examining the problem of education in the light of the new world order which prominent thinkers and statesmen are visualizing.

It is generally recognised that the present system has many inherent defects. To prevent a recurrence of the war and secure an ordered progress of the world, the system of education needs to be modified. Education of the youth is the vital foundation on which the progressive, peaceful and humane reconstruction should be organised; it is only through a well-conceived system of liberal and humanising education that the long-cherished hope of maintaining ever-lasting peace and of securing universal prosperity can be fulfilled.

In India the problem of educating the 400 millions and raising their economic standard, has received the earnest attention not only from the Government but also from our national leaders. The Wardha Scheme, inspired by Mahatma Gandhi, is intended to unfold the full personality of the individual and qualify him for a creative and corporate life in a democratic community. The Sargent Scheme lays down a plan through which the nation is prepared to shoulder the responsibilities of a modern democratic administration. The Sargent Plan which incorporates a good many important points outlined in the Wardha Scheme, has earned for itself the reputation of constituting one of the most practical and comprehensive schemes ever evolved for educating the people of this land. In addition we have the post-war reconstruction schemes pertaining to every department of nation-building, post-war agriculture, post-war industrialisation, and post-war plans for scientific and industrial research. Leading industrialists of this country have put forward the fifteen-year, 10,000 crore scheme, generally known as the "Bombay Plan", for the industrial regeneration of this country.

These gigantic schemes need the services of an army of trained personnel, teachers, technologists, administrators, and scientific men. To reap the full benefits of a democratic way of life, and of the four freedoms which are enunciated as the birthright of every nation on this globe, the people must be educated and illiteracy which, in this country, exists to the extent of 85 per cent. removed. In the abolition of illiteracy and in the training of personnel to man the schemes of reconstruction, it is the humble teacher that has to play the fundamental role. The teachers lay the foundation

of the edifice of national regeneration and national prosperity. They constitute the master instruments through which reconstrucion plans have to be put through. These facts are not generally recognised to the extent they should be and strangely enough, the profession of teaching, in spite of the vital and strategic position which it occupies in the body politic, still remains one of the most unremunerative of the learned professions. It is argued that there are no financial prizes, such as men strive for in business. The teacher must find his reward not in the form of high salaries or accumulated fortunes but in the intellectual life of the scholar, "in the fellowship of cultivated colleagues in the companionship of young minds and young hearts" and in the gratitude and friendship of his students. These are worthy ideals which most teachers appreciate and practise when they are provided with adequate means for leading a life of dignity and modest satisfaction. But when the teacher is faced with the spectre of domestic penury, as he is to-day in India, and when he has to run the risk of an uncertain future for himself and his dependants, he naturally feels neglected and discouraged.

It is flattering neither to a progressive state marching towards democracy, nor to an enlightened public aspiring for freedom, that the teacher who constitutes the central figure destined to ultimately influence every sphere of nation-building, should find himself neglected, unrecognised and in a condition of abject poverty. Elsewhere in this issue (p. 162) Sir S. S. Bhatnagar has drawn pointed attention to the lamentable conditions, which characterise the economic status of the teacher in this country. Relevant portions of a letter to him from a science teacher are also reproduced in this issue (p. 163). A grave situation has arisen; immediate relief should be provided.

Progressive nations have realised that teachers constitute by far the most powerful instruments through which a people may control its future destiny. The teacher is the animating force which kindles in the young the passion for knowledge, freedom, truth and justice. The teacher in Japan enjoys the privilege of being the first to be interviewed by the Emperor when he visits a village. The economic condition of teachers in other countries are far more satisfactory than what their Indian compeers enjoy in this country. Americans, in particular, have recognised the value of teachers in a most effective and practical manner. There is the Carnegie Foundation for the advancement of teaching, which takes upon itself the task of protecting and promoting the interests of the community's most precious asset—the teacher.

Andrew Carnegie, the illustrious American benefactor, wrote to his trustees on April 16, 1905, "I have reached the conclusion that the least rewarded of all professions is that of the teacher in our higher educational institutions. I have therefore transferred to you and your successors, as trustees, ten millions of dollars, of five per cent. Mortgage bonds of the United States Steel Corporation, to provide retiring pensions, for the teachers of universities, colleges and technical schools in our country, Canada and Newfoundland, under such conditions as you may adopt from time to time". Later, the gift was increased to fifteen millions of dollars. Is it too much to expect that some of our enlightened industrial magnates will likewise come forward to retrieve a situation which is growing worse day by day? The Central Government and the informed public should take up this matter and reorganise the teaching profession in a manner which will restore it to its rightful place in society.

IDEALS FOR TEACHERS

ADDRESSING the Secondary School Teachers' Association, Sir S. Radhakrishnan, Vice-Chancellor of the Benares Hindu University, said: "I believe the teaching profession, whatever may have been its past, has a very great future before it. Education is the main thing by which we can develop radically new types of men, if we so desire. We have our own system of education and our ideals. People might come forward and ask us: Is it any good pursuing your own ideal at the present moment? I must say that the political and economic condition of India need not be regarded as invalidating the spirit of Indian culture any more than the present war may be said to invalidate the spirit and the value of science. We do not say because the world is at war and science is being abused, therefore science is invalidated. We cannot say that because we are in the present unfortunate condition politically and economically, the ancient Indian wisdom is futile. We require the wisdom—enlightenment as well as knowledge—that is power. If we have failed, it is because our philosophy or our wisdom did not have enough practical application. If science has failed, it is because science has not looked to philosophy for guidance. A combination of these two will help our own country."

THE MAHARAJAH OF TRAVANCORE LECTURERSHIP IN APPLIED CHEMISTRY

A GRANT of Rs. 3,000 per annum has been sanctioned by the Government of Travancore to the Indian Institute of Science, Bangalore, for three years from 1120 (1944-45) for a Lecturership in the Department of Applied Chemistry, to be called "The Maharajah of Travancore Lecturership in Applied Chemistry."

SIR ARDESHIR DALAL

EVERY section of informed public opinion, and the scientists and industrialists in particular, will warmly welcome the statesmanlike decision of the Governor-General to invite Sir Ardeshir Dalal to accept the membership of the Executive Council and assume charge of the newly created Department of Planning and Development.

The Government have felt that planning for the post-war period has now reached a stage at which it requires the exclusive attention of a separate member who will be free from the ordinary Departmental routine.

Sir Ardeshir Dalal is not only an eminent administrator of outstanding ability but an experienced industrialist with an intimate practical knowledge of the industrial needs of this country. He has been closely associated with everyone of the great industrial enterprises of the Tatas and has kept himself in sympathetic touch with the progress of scientific and industrial research. He was elected General President of the Indian Science Congress held in Benares in 1941. He has taken a keen and lively interest in guiding the policy and affairs of the Council of Scientific and Industrial Research and in giving practical shape to the National Laboratories.

As one of the distinguished signatories of the much discussed fifteen year, 10,000 crore "Bombay Plan" for India's industrial regeneration and social advancement, he is fully conversant with the national aspirations in this regard. His wide and varied administrative experience will, at the same time enable him to realise the difficulties which are bound to be encountered in practical materialisation of

the plan. Sir Ardeshir Dalal's appointment as Member will be acclaimed as a practical proof of the Government's earnestness to approach the nationalistic plan of post-war reconstruction with sympathy and understanding.

NEW DEVELOPMENTS IN PLASTICS

A U.S. manufacturer is producing plastic helmet liners for the Army by a simple process, using low-cost molds. In a preforming operation, resin-impregnated cotton ribbons are wound around a hot, oval mandrel by automatic wrapping machines. The fabric "melon" so produced is cut into halves, each a helmet preform. Instead of employing hydraulic presses and elaborate machined steel dies, the company built several inexpensive steel frames. A fixed platform is bolted to the top of the frame, and a movable platform, actuated by means of a small air cylinder, rides between the frame members at the bottom. The cavity of the mold is permanently mounted on he upper platform, and is merely a rough cast iron shape which is chrome plated so that a high finish may be imparted to the completed piece. The force plug of the mold is also a rough casting, somewhat smaller in size than the inside of the helmet liner. Both the force plug and the upper mold cavity are cored for steam. In the molding operation, first a rubber bag and then the preform itself is placed over the force plug, and the mold is closed. Water of 250 pounds per square inch (17·6 atm.) flows between the plug and the bag; thus, the pressure necessary for molding is obtained. Heat is transferred from the steam-heated plug through the water to the helmet liner. After a six-minute curing cycle, the pressure is released from the rubber bag and the lower platform dropped, whereupon the liner is released by blown air. One girl operator easily manages seven presses.

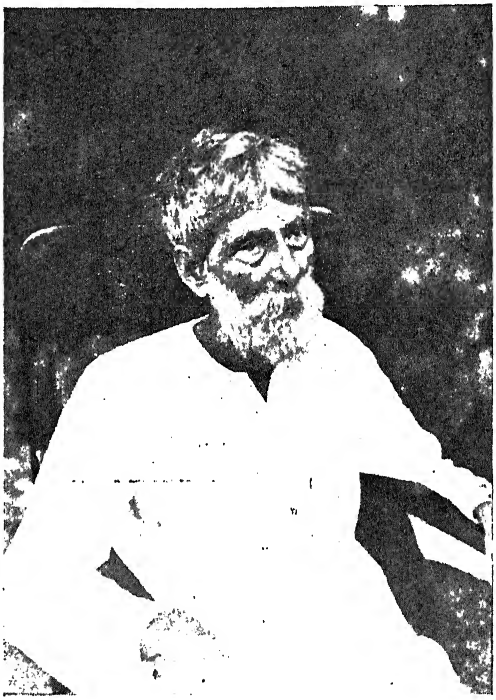
By the wound preform and air bag method, an estimated 15 to 20 per cent. saving in materials is effected. The fabric will not be crushed, but simply be compressed together to a uniform thickness, free from wrinkles, with a more even distribution of fabric and resin. The method is ideal for producing irregular shapes such as curves and globular forms and is highly adaptable to the production of small lots of high-strength parts to be produced quickly and cheaply. It is expected that this type of construction will prove significant in post-war production of furniture, cars, refrigerators and many other pieces of unusual contours.

OBITUARY

ACHARYA SIR PRAFULLA CHANDRA RAY

(Aug. 2, 1861—June 16, 1944)

IT is with the deepest regret that we record the death of Acharya Sir Prafulla Chandra Ray, at the age of 83. He passed away at the University College of Science, Calcutta, which has been both the home in which he lived and the place where he carried on his scientific work.



An eminent chemist, an inspiring teacher, a distinguished educationist, a pioneer industrialist, a great patriot and a noted philanthropist, Acharya Ray occupied an unique position in the scientific, industrial and cultural life of this country. He belonged to that generation of our great men who wrought a great change in the spirit of our age.

His monumental work on the *History of Hindu Chemistry* served to remind his countrymen of the great traditions of chemical research which they had inherited and inspired them to further achievement on modern lines.

He was a sincere friend of the poor and the destitute. He identified himself with the organisation of several relief measures for the amelioration of the economic distress which followed floods, famines and other disasters. His heart and purse were freely available to those who sought them. He had bequeathed the entire proceeds from his salary, aggregating to a few lakhs, to the University of Calcutta as an endowment for expanding the laboratories at the University College of Science and for the advancement of research in general.

He responded to the call of Mahatma Gandhi and threw himself heart and soul in spreading the message of *Charka* and *Khaddar* throughout the length and breadth of this country.

The greatest and the most enduring of his contribution to the advancement of science and industry in this country is the founding of a school of research in chemistry. To quote Gandhiji, "In the death of Dr. P. C. Ray the country has lost a very great scientist and an equally great philanthropist. He was also a great patriot and a friend of the poor. His spartan simplicity was a pattern for all, but more especially for the student world."

We are grateful to Sir J. C. Ghosh, Kt., D.Sc., F.N.I., Director, Indian Institute of Science, for permission to reproduce this exclusive and characteristic portrait of Acharya Ray.

INTELLECTUAL WORKERS' UNION

PROF. ALBERT EINSTEIN has suggested formation of an "Intellectual Workers' Union" in a statement to the National Wartime Conference. The father of the Relativity Theory said, the Union would be designed "to fight for the establishment of a supernational political force as protection against fresh wars of aggression. Intellectual workers should unite not only in their own interests but also, and no less importantly, in the interest of society as a whole. It is inevitable, in considering the progressive centralisation of production, that the economic and political struggle should become more closely interwoven. Meantime, the intellectual worker, due to his lack of organisation, is less well protected against arbitrariness than the member of any other calling. The division among intellectuals partly is to blame for the fact that the special experience which is the birthright of those groups so seldom is seen to be available for political aims. Political ambition and desire for profit almost exclusively determine events, instead of professional knowledge and judgment based upon objective thinking."

THE FOUR FORMS OF DIAMOND*

BY SIR C. V. RAMAN

FROM the earliest times, the diamond has rightly been recognized as Nature's choicest product in the mineral world. Its claims to the attention of the scientific investigator are also of the strongest kind. The crystal form and the structure of diamond afford the clearest possible proof of the tetrahedral symmetry of the carbon atoms and the most striking illustration of their quadrivalence and of their capacity to combine with each other in limitless number. To the physicist, diamond is the prince of solids, and the study of its properties opens up many new pathways of knowledge into the domain of the crystalline state of matter.

Purely crystallographic considerations indicate that the structure of diamond should have four possible forms. This follows at once from the fact that the structure may be described as a repetition pattern in which the unit consists of *two* carbon atoms, each of which possesses only tetrahedral symmetry. The four axes characteristic of such symmetry have both direction and sense, and while the directions are necessarily the same for the two representative atoms, the senses may be different, and we have, therefore, 2×2 or four possible settings in space of these axes relative to each other. In two of them, the crystal as a whole would have only tetrahedral symmetry, and they may be described in the language of geometric crystallography as the positive and negative tetrahedral forms, which are physically identical, and are only geometrically different from each other. In the other two settings which are both physically and geometrically different from each other, the crystal would have full octahedral symmetry.

These theoretical considerations are confirmed in a remarkable way and independently by the crystallographic evidence, and by the spectroscopic behaviour of diamond. The appearance of crystal forms characteristic of ditesseral polar symmetry had led the earlier crystallographers to assign to diamond only the lower or tetrahedral symmetry and to explain the frequent appearance of octahedral forms as due to interpenetration twinning of the positive and negative tetrahedral forms. The correctness of their verdict, at least as regards the majority of diamonds, is triumphantly vindicated by the spectroscopic evidence, which shows that the characteristic lattice frequency of 1332 cm.$^{-1}$ is *active* in infra-red absorption in most diamonds. It is known, however, that, in some diamonds, this characteristic frequency is infra-red *inactive*, thereby indicating that such diamonds possess the full octahedral symmetry of the cubic system. Theory indicates, however, that *the characteristic frequency should be active in light-scattering in both cases*, and this again is in agreement with experiment. The evidence thus makes it clear that the considerations set forth above stand on an irrefutable basis.

The energy of binding of the carbon atoms with each other, though of a covalent nature, is essentially of electrostatic origin. Hence, if the distribution of static charge were noticeably different in the different possible structures, they would easily be distinguishable from each other by such simple tests as density or refractivity. Since this is not the case, we are led to recognize that the differences are of a more subtle kind, and are probably connected with the configuration of the orbits and the intrinsic spins of the electrons within the crystal. Diamond is diamagnetic, and the orbits and spins must be so arranged that the magnetic moments associated with them cancel out in the aggregate. In the structures having only tetrahedral symmetry, the individual moments associated with the carbon-carbon bonds should persist, while the aggregate moment vanishes by reason of their tetrahedral setting in space. On the other hand, an octahedral symmetry of structure is only possible when the magnetic moments associated with each carbon-carbon bond cancel out individually.

The close similarity in structure of the four possible forms of diamond suggests that the simultaneous appearance of two or even all four in an individual diamond should be a common occurrence. The least disturbance to the regularity of crystal structure would occur when the positive and negative tetrahedral forms interpenetrate, since these are physically identical. The interpenetration would occur without setting up strains in the crystal, and such a diamond should, therefore, appear isotropic when examined under the polariscope. On the other hand, the two forms having octahedral symmetry being physically different, their mutual interpenetration may be expected to take the form of an alternating or lamellar twinning, and even the smallest difference in the lattice-spacings of the two forms would result in such twinning making itself evident under the polariscope by reason of the birefringence set up. Interpenetration of the tetrahedral and octahedral structures also should give rise to observable birefringence on account of the physical differences between them. These inferences from the theory are found to be in complete accord with the facts.

Apart from the birefringence resulting from the interpenetration of structures differing from each other as explained, there are other physical properties which arise from, or are influenced greatly by, such interpenetration. Amongst these should be mentioned specially the power of the diamond to luminesce or emit visible light under ultra-violet irradiation or the impact of X-rays, the extent of transparency of the diamond in the visible and the ultra-violet regions of the spectrum, its photoconductivity under visible or ultra-violet irradiation, and the reflecting power of the crystal planes for X-rays. The symposium contains reports of

* "Symposium on the Structure and Properties of Diamond," *Proc. Ind. Acad. Sci.* A, May 1944, p. 189-342, and Plates III to XXX.

investigations on all these topics. Not only are these properties capable of enormous variations from specimen to specimen, but such variations may also occur within an individual crystal or cleavage plate of diamond. Thus the possibility arises of individual diamonds exhibiting *patterns of luminescence, patterns of ultra-violet transparency,* and *patterns of X-ray reflection or X-ray topographs.* The discovery of the existence of such patterns and of the similarities and differences between them as observed in the same diamonds forms a notable contribution to the physics of the diamond made in the symposium. Numerous photographs of them are reproduced together with the catalogue numbers of the diamonds to enable the reader to compare the different kinds of patterns of the individual diamonds.

a blue luminescence, the 5032 and the 4152 systems invariably appear together when the luminescence exhibits other colours such as green or yellow. No trace of either system is recorded with non-fluorescent diamonds.

An explanation for these facts comes directly out of the theory indicated above. Blue luminescence arises whenever the tetrahedral structures interpenetrate into one another. On the other hand, the lamellar twinning of the octahedral structures produces no luminescence; but if the octahedral structure intermingles with the tetrahedral, then yellow luminescence results. In an actual specimen, the nature and extent of the interpenetration of the different structures may vary, and this is the origin of the high variability of the intensity and colour of fluorescence. Precisely the same explanation is sufficient to account for the patterns of luminescence exhibited by many diamonds. The local variations of colour and intensity in such cases clearly arise from corresponding variations in the structure of the diamond.

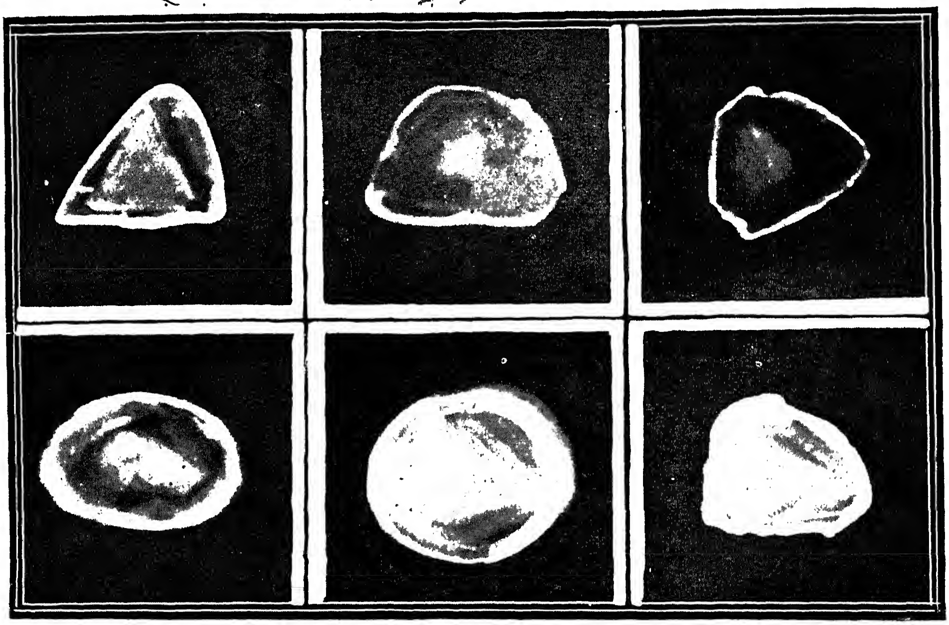


FIG. 1. Luminescence Patterns in Diamond

The luminescence of diamond in its various aspects forms the subject of a series of papers in the symposium. The intensity as well as the colour of the luminescence is highly variable, while some diamonds are definitely non-luminescent. A very thorough investigation by Miss Anna Mani shows that the spectral character of the emitted light may be described in terms of two distinct systems, which may be referred to as the blue and the yellow luminescence spectra. The former is associated with a sharp bright line at 4152 Å, while the latter is similarly associated with a sharp bright line at 5032Å, these being in each case accompanied by subsidiary lines and bands. The absolute and the relative intensities of the 4152 and the 5032 systems vary enormously from diamond to diamond, thus fully accounting for the observed variations of the colour and intensity of luminescence. While the 4152 system alone appears in some diamonds giving

The foregoing interpretation of the origin of luminescence in diamond and of the appearance of luminescence patterns therein finds a striking confirmation in the results of a spectroscopic study of the ultra-violet transparency of diamonds by Sunanda Bai, and of direct observations of the transmission through diamond of the 2537 Å radiations of the mercury arc made by Mr. Rendall. It is found that blue-luminescent diamonds are invariably of the ultra-violet opaque type; but the opacity diminishes with increasing intensity of luminescence. The spectrum shows a cut-off at 3050Å in weakly blue luminescent diamonds, but progressively extends into the ultra-violet in intensely luminescing diamonds even up to

2450 Å. The non-fluorescent diamonds are ultra-violet transparent, transmitting freely up to 2250Å, or even beyond. On the other hand, in diamonds of the yellow luminescing kind, the transparency in this region is very imperfect. A strong absorption doublet, accompanied by subsidiary bands on either side appears at about 2360 Å in diamonds that show both the 4152 and the 5032 systems.

diamond. Such variations have in fact been made manifest by a new method of obtaining Laue reflections using X-rays diverging from a pinhole, adopted by Mr. G. N. Ramachandran. By suitably tilting the crystal, and the photographic plate, an almost perfect reproduction (X-ray topograph) of the variations in the crystal structure can be obtained. A comparison of these topographs with the other patterns

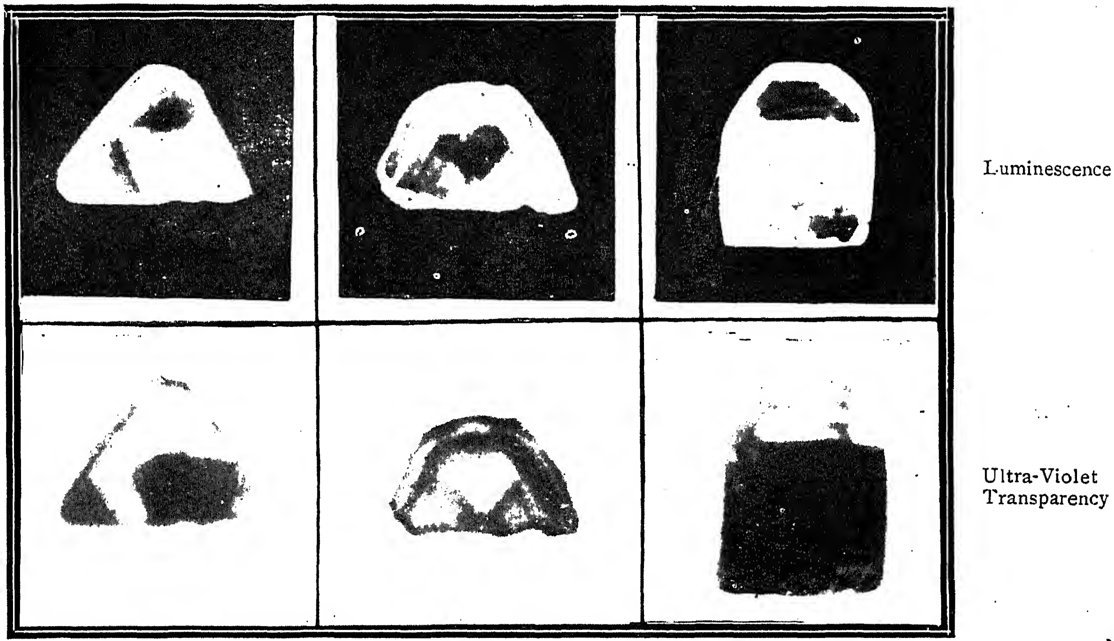


FIG. 2. Comparison of Luminescence and Ultra-Violet Transparency Patterns

X-ray studies furnish a further striking confirmation of the ideas stated above. As already described, the two tetrahedral structures can interpenetrate freely without setting up stresses in the crystal. Nevertheless, the mixed structure is not ideally homogeneous, so that its lattice planes should give stronger X-ray reflections than those given by either structure individually, the intensity being larger, the greater the extent of interpenetration. Hence, one should expect a close correlation between the intensity of blue-luminescence, and of X-ray reflection. This inference has in fact been confirmed by Dr. R. S. Krishnan both by the Laue and the Bragg methods. The interpenetration of the octahedral structures, on the other hand, sets up strains in the crystal, so that such a mixed structure should show much more intense X-ray reflections than the blue-luminescing diamonds. For the same reason, the yellow-luminescent diamonds should exhibit an X-ray reflection intermediate between the above two types. These conclusions have also been borne out by the investigations of Mr. P. S. Hariharan. A natural consequence of the above considerations is that one should also expect variations in the X-ray reflecting power over the area of a cleavage plate of

is very interesting, and shows that the enhanced intensity may be of two types. It may be caused either by an increased interpenetration of the tetrahedral structures or by the intrusion of the octahedral type. Mr. Ramachandran has found that this increase is different for the different crystal planes, the factor of increase being greatest for those having the largest structure-amplitude, and decreasing to unity for feebly reflecting planes.

Observations of the characteristic streaky birefringence of the ultra-violet transparent type of diamond suggests that it has a piezo-optic effect due to the crystal spacings of the two modifications of octahedral diamond being different from each other. We should expect on this basis that the optic axes of the birefringence should be parallel and perpendicular to the intruding layers, and this is actually the case. It is gratifying also to be able to report that direct experimental proof has been obtained for the difference in the lattice spacing of the two octahedral modifications. Using the oscillating crystal method, and a diamond in which the two structures coexist in adjacent layers of the crystal, Dr. Krishnan has found that the Bragg reflections exhibit a waviness, showing clearly that there is a

difference in the crystal spacing of the alternate layers. These observed differences suggest that there should also be a difference in the spectral frequency of the lattice vibrations. Dr. Krishnan has also obtained evidence of this by a careful study of the width of the 1332 line observed.

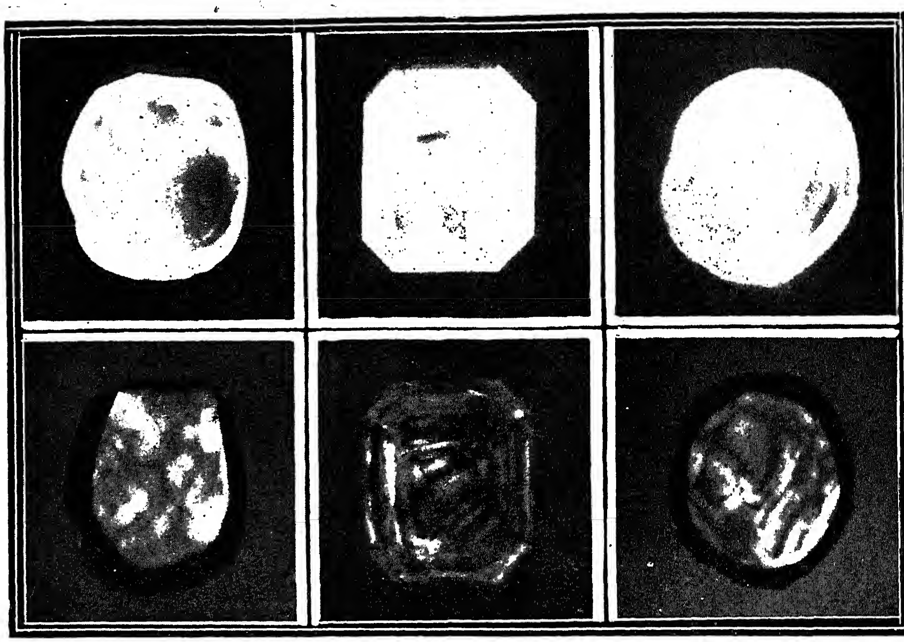


FIG. 3. Comparison of Luminescence and Birefringence Patterns

Reference must also be made to other results of importance announced in the symposium. Dr. Krishnan has studied the scattering of light in diamond in great detail, using the Rasetti technique, and has obtained ten other lines, besides the well-known line with a frequency shift of 1332 cm.$^{-1}$ These new lines have been identified as the octaves and the allowed combinations of the eight frequencies of oscillation of the diamond structure, calculated according to the principles of crystal dynamics developed by the present writer. These lines are not permitted to appear as fundamentals in light-scattering by reason of the selection-rules, but appear in fluorescence in combination with electronic frequencies. The frequencies calculated from Dr. Krishnan's results are found to agree well with the frequencies deduced from fluorescence spectra by Dr. Nayar and Miss Mani. Using the experimental values for the fundamental frequencies, Mr. Bisheshwar Dayal has evaluated the specific heat of diamond, the calculated values agreeing perfectly well with the experimental data throughout the entire range of temperatures.

There is only space here for a brief reference to a paper by Mr. A. Sigamony on the magnetic susceptibility of diamond, and to two papers by Mr. Pant on the photoconductivity of diamond. The latter has studied the photoconductivity of a large number of diamonds, and has interpreted his results on the basis of the variations in the structure of the crystal as described above. Mr. Ramaseshan reports some interesting studies of the crystal forms of the Panna diamonds, and particularly of the nature of the curvature exhibited by their surfaces.

A NEW PUNJAB OIL-FIELD

A CABLE from London to Mr. D. N. Wadia from Mr. E. S. Pinfold, Chief Geologist of the Attack Oil Co., announces the successful results of the boring tests proving the existence of natural oil (petroleum) at Joya-Mair village, near Chakwal, in North-West Punjab. This area was geologically suveyed in course of his Potwar Survey by Mr. Wadia, who discovered this favourable oil-storage structure at Joya-Mair and reported it to the Government in 1926, suggesting this area as a possible oil-field in a paper published in the *Records, Geological Survey of India*, in 1929. For fourteen years this discovery remained untested by actual drilling trials.

AN EARLY REFERENCE TO NIGHT-BLINDNESS IN INDIA, AND ITS RELATION TO DIET DEFICIENCY

By W. R. AYKROYD
(*Nutrition Research Laboratories, I.R.F.A., Coonoor*)

REFERENCES to the treatment of night-blindness by liver are to be found in ancient medical writings. In an Egyptian medical treatise, Eber's Papyrus, to which the date 1500 B.C. has been assigned, the roast liver of an ox, and the liver of a black cock, are mentioned as curative agents. Hippocrates recommends "ox liver, raw and dipped in honey". The curative effect of liver on night-blindness appears, indeed, to be part of traditional medical lore in many parts of the world including India.

After the discovery of vitamin A in the present country, the association between night-blindness and vitamin A deficiency was established and an explanation provided of the efficacy of liver in the treatment of the condition. Later work revealed that vitamin A is required for the regeneration of visual purple, which sensitises the retina for vision in dim lights. A large amount of inconclusive work has been carried out on dark adaptation tests to detect early evidence of vitamin A deficiency. There are other causes of night-blindness besides vitamin A deficiency and the physiological process of dark adaptation is a complicated one. But unquestionably there is a classical form of night-blindness, occurring in malnourished people, which responds to treatment with vitamin A in the form of liver or liver oil, and other concentrated sources of vitamin A and carotene. The response in the classical conditions is often dramatic; the tradition of the value of liver could scarcely have been established unless this were so. The author[1] has described night-blindness among Newfoundland fishermen living on a diet deficient in vitamin A. The fishermen treated themselves by taking cod liver oil, cod liver, seal liver, hen's liver, gull's liver, etc., and by such means cured themselves to their own satisfaction within 24 to 48 hours. It is possible, of course, that dark adaptation did not become completely normal within this short period, but a fisherman on a dark and rocky coast cannot to any serious extent deceive himself and his comrades about the acuity of his night-vision.

Much of the recent work on dark adaptation has been carried out on relatively well-nourished individuals who were not night-blind in the clinical sense—*i.e.*, their condition was not such as to lead to social disability because of failure to see in a dim light and impel them to seek treatment. Investigations have been concerned largely with minor degrees of impairment of dark adaptation detectable only by refined dark adaptation tests. Under such conditions no very clear-cut relation between impaired dark adaptation and diet deficiency has been observed. The growth of the literature describing experimental work along these lines has tended to obscure earlier clinical observations on night-blindness which clearly showed that there is a common form of the disease occurring in malnourished subjects and responding to treatment with vitamin A. It is, therefore, interesting to find that the dietetic origin of night-blindness (or of one kind of night-blindness) was recognised in India over a hundred years ago.

The passage quoted below is from "Narrative of a Journey through the United Provinces of India from Calcutta to Bombay, 1824-25", by the Right-Rev. Reginald Heber, Lord Bishop of Calcutta (Third Edition, 1828, Vol. 11, p. 485). The town referred to is Chitoor in Rajputana.

> "In our way back through the town a man begged of me, saying that he was blind. On my calling him, however, he came forwards so readily to the torches, and saw, I thought so clearly, that I asked him what he meant by telling me such a lie. He answered that he was night-blind ('*rat unda*'), and I, not understanding the phrase, and having been a good deal worried during the day with beggars, for the whole fort is a swarm of nothing else, said peevishly, 'darkness is the time for sleep, not for seeing'. The people laughed as at a good thing, but I was much mortified afterwards to find that it was an unfeeling retort. The disease of night-blindness, that is, of requiring the full light of day to see, is very common, Dr. Smith said, among the lower classes in India, and to some professions of men, such as soldiers, very inconvenient. The Sepoys ascribe it to bad and insufficient food, and it is said to be always most prevalent in a scarcity. It seems to be the same disorder of the eyes with which people are afflicted who live on damaged or inferior rice, in itself a food of very little nourishment, and probably arises from a weakness of the digestive powers. I was grieved to think I had insulted a man who might be in distress, but Dr. Smith comforted me by saying that, even in respect of night-blindness, the man was too alert to be much of a sufferer from the cause which he mentioned."

Bishop Heber, author of the well-known hymn which begins "From Greenland's icy mountains", was unquestionably a remarkable man, who when not occupied in establishing missions and preaching long sermons, studied the people, social customs, archæology, and agriculture of India with eager scientific curiosity. His dynamic career came to an early close. He died of apoplexy at the age of 43 in a swimming bath at Trichinopoly, having entered the bath to cool himself off after a strenuous morning occupied in devotional and administrative duties. The bath, with a commemorative inscription to Bishop Heber, is still in existence.

Dr. Smith I have not been able to trace. He was an army doctor who joined the bishop's party at Meerut and proceeded with it to Bombay.

The striking part of the quotation is the statement that the Sepoys recognized that

night-blindness is a food deficiency disease. This is rather a different thing from traditional knowledge of the value of liver in treatment. To the best of my recollection, the Newfoundland fishermen, while they knew how to cure night-blindness by liver, did not clearly understand that it was caused by their poor diet, and in other parts of world knowledge of the method of treatment does not seem to have involved recognition of etiology. The passage may, therefore, be worthy of a place in the history of ophthalmology and nutrition.

1. *Jour. Hyg.*, 1930, **30,** 357.

COCONUT SHELLS AS AN INDUSTRIAL RAW MATERIAL

III. ESTIMATED WORLD PRODUCTION

Dr. REGINALD CHILD
(Director, Coconut Research Scheme, Ceylon)

THE first of this series of articles[17] dealt with the chemical composition of coconut shells; and the second[31] with miscellaneous uses of shells as such and with their value as fuel.

It is convenient at this stage to consider briefly the world output of coconuts and the corresponding availability of coconut shells, since in discussing (in latter articles) potential utilization of shells it is necessary to have a working idea of the quantities produced.

World Production of Coconuts

Estimates of world production are not very precise. Fairly good statistics are available for the Philippines prior to the Japanese occupation, and the writer's estimates (1939)[32] for Ceylon are believed to be reasonably near the truth. Statistics are usually available for exports of coconut products from countries of origin; local consumption is, however, very difficult to estimate.

Probably the most ambitious attempt to assess world production of coconuts has been that of Leo Schnurmacher, Inc., of the Philippines (1938)[33] and the following table is to a large extent adapted from their publication:

Table I
Annual Production of Coconuts (Estimated)

Country	Area Planted (Acres)	% of World Total Acreage	No. of Trees (1000's)	Trees per Acre	Bearing Trees (1000's)	Annual Production of nuts (1000's)	Nuts per bearing tree per yr.	Nuts per Acre per year
Netherlands Indies ..	2,943,700	30·6	169,159	57	152,243	6,000,000	39	2038
Philippines ..	1,571,500	16·3	120,696	77	90,360	4,299,000	48	2736
India ..	1,475,900	15·3	83,917	57	78,815	3,032,600	38	2055
Ceylon ..	1,100,000	11·4	60,500	55	51,425	1,853 200	36	1685
Malaya ..	609,200	6·3	24,357	40	24,039	1,309,100	54	2149
New Guinea ..	296,000	3·1	14,372	49	11,538	438,500	38	1480
Others ..	1,622,300	17·0	84,863	52	62,245	2,598,300	42	1602
	9,618,300	100·0	557,864	58	470,665	19,530,700	42	2030

The estimates in Table I attempt to include locally consumed products, and so are considerably higher than those of Snodgrass (1928)[34] or of the International Institute of Agriculture (1939),[35] which are only concerned with commodities entering world commerce.

It will be observed that, according to Table I, six major producing countries account for the bulk of world production, and it is certain that these countries provide over 90 per cent. of coconut products entering world trade.

Average Weight of Shells

Coconuts vary considerably in size, the greatest differences being varietal. Varieties range from the dwarf types, which may weigh as little as 250 grams per husked nut, to the large San Ramon nut of the Philippines, which when husked may weigh as much as 2,000 grams. The weight of the shells, though of course greater for the larger nuts, does not run exactly parallel to the weight of husked nuts. In general, as would be expected on mathematical grounds, the weight of the shell forms a smaller proportion of the total weight of husked nut in the case of the larger varieties. Thus, H. S. Walker (1906)[36] gave for San Ramon nuts an average of 20 per cent. for the ratio of shell weight to husked nut weight; for average Ceylon nuts the figure is about 25 per cent., and for dwarf nuts it may reach 35 per cent. This general rule is not a rigid one, since varietal differences in shell thickness occur. For example the Ceylon "Bodiri" type of nut has a very thin shell, and the "Porapol" type, similar in size, has a very thick one. However, within a population drawn from one variety the general rule has some application, as will be seen in the fuller discussion below.

* It should be noted that in the whole of this discussion, unless otherwise stated, the reference is to ripe nuts stored in the field one month before husking, as usual in Ceylon estate practice.

Apart from varietal differences, the size of nuts is affected by soil conditions, elevation and climate. In discussing these factors, it is for two reasons convenient to confine attention to the medium-sized nuts of the tall palms widely grown in Ceylon; these are the economic type most commonly grown; and for them more accurate information is available than for other types.

It was shown by Cooke (1934)[37] that there is a high correlation between weight of husked nut and wet meat. Pieris (1935)[38] extended this to copra; very high correlations were demonstrated between weight of husked nuts and of copra therefrom and Pieris concluded that for purposes of field experimentation 32 per cent. could be taken as the ratio between weight of copra and of husked nuts.* It must be noted, however, that this figure is only applicable to nuts from tall Ceylon palms growing under normal soil and climatic conditions; Pieris' work covered a range of husked nut weight of 650 to 950 grams. H. S. Walker's figures (*loc. cit.*) show that the ratio is much lower for the large San Ramon nuts, and later unpublished observations of Pieris (1943) that it may reach 40 per cent. for dwarf nuts. Child and Salgado (unpublished observations, 1944) have further shown that, even within the same population, the copra/husked nut ratio is higher for the smaller nuts, *i.e.*, that it follows the same general rule as the shell/husked nut ratio, although the range is not quite so wide; their data is summarised below. Within the "normal" range covered by Pieris' original work, the 32 per cent. copra ratio is sufficiently accurate for practical purposes, and similarly a ratio of 25 per cent. for the shell/husked nut ratio is a sufficiently close approximation [*cf.* Child, (1940)].[40]

Drought markedly affects nut size, and Park (1934)[39] has published figures showing that the yield of copra per thousand nuts markedly declines for about a year after severe drought with a maximum effect about six months after the drought; he quotes records from an estate near Puttalam, Ceylon, where the average outturn was roughly 500 lbs. copra and where after a severe drought in 1931 nuts picked in February-March 1932, gave only 325 lbs. copra per 1,000 nuts. Nut size and corresponding copra outturn are adversely affected, though less markedly than by drought, by inferior soil conditions and are to some extent improved by adequate manuring.

Child and Salgado (see above) have examined the figures for 54 lots of nuts from the plots of a manurial experiment, in all 5,023 nuts. When these were grouped according to husked nut weight into nine lots of six plots each, the following results were obtained (Table II *a*). The only notable effect of manuring was the increase in nut size produced by application of potash fertilizers, though there is some evidence that excessive applications of nitrogen *reduce* nut size.

Table II(*a*) may be translated into practical terms. It is usual to estimate the commercial value of nuts by the number required to yield a standard weight of copra, *e.g.*, in Ceylon nuts per candy of 560 lbs., in Malaya per picul of

TABLE II(*a*)

No. of Nuts	Average Wt. Husked Nut. Grams	Average Wt. of Copra per nut Grams	Average Wt. Shell per nut Grams.*	Copra Wt. % / Husked Nut Wt.	Shell Wt % / Husked Nut Wt.
401	534	190	157	35·5	29·4
463	607	207	164	34·0	27 0
387	650	220	169	33·8	26·0
595	680	222	173	32·7	25·4
662	704	226	177	32·2	25·1
624	730	241	180	33·0	24·6
665	767	247	190	32·1	24·8
570	817	259	200	31·7	24·5
653	857	269	208	31·4	24·3
General 5023 Average	719	234	182	32·6	25·3

$133^1/_3$ lbs., and in general statistics per long ton of 2,240 lbs. Similarly, in Ceylon at least, shells are valued on the number of whole-shells to a ton. Extrapolation of the data in Table II(*a*) gives the following:—

TABLE II(*b*)

Nuts to give of Copra :—			Wt. of 1,000 Husked Nuts in Lbs.	Wt. of 1,000 Whole Shells in Lbs.*	No. of Whole Shells to a Ton
1 Picul	1 Candy	1 Ton			
225	950	3800	1880	456	4910
240	1000	4000	1760	432	5190
250	1050	4200	1625	409	5480
260	1100	4400	1530	387	5790
275	1150	4600	1440	373	6000
285	1200	4800	1375	365	6140
300	1250	5000	1305	358	6260
310	1300	5200	1235	351	6380
320	1350	5400	1165	344	6510
335	1400	5600	1125	340	6590

WORLD AVAILABILITY OF COCONUT SHELLS

In computing world statistics it has been customary to take 5,000 nuts as representing a long ton of copra (*cf.* Child[32]). It is convenient to take a corresponding approximate figure of 6,000 shells to a ton in estimating production of these. On this basis the following estimates may be made of production of coconut shells in the six major producing countries:

* The weights given are all of shells from copra-drying kilns; they are thus in a drier condition than if (as in desiccated coconut manufacture) the shells are chipped off from the nut before drying Figures for such fresh chipped shells from nuts of out-turn 1,100 candy have given 27–28 per cent. for the shell/husked nut ratio against 25 per cent. for dry shells. The lower figure is preferred for the practical table as most shells will come from copra drying.

TABLE III

Annual Production of Coconut Shells (Estimated)

	Tons
Netherlands Indies	1,000,000
Philippines	700,000
India	500,000
Ceylon	300,000
Malaya	220,000
New Guinea	73,000
	2,793,000

This production of nearly three million tons annually is, of course, negligible in comparison with that of such raw materials as coal or timber, and a sense of this proportion must be maintained in any consideration of the scope of coconut shells as an industrial raw material. In each country, too, the utilization of shells will depend not only upon production but upon availability and concentration of supplies. A large proportion of production in Malaya and New Guinea is from comparatively large well-managed plantations, whilst in India small-holdings account for most of the coconuts; collection of shells in bulk would, therefore, be easier in the former. Again in Ceylon there exist, more than in the other countries, considerable factories (oil-milling and desiccating) which handle nuts in quantity and where in consequence shells are already collected. These factors must all be taken into account—together with such forms of utilization as already exist (*e.g.*, for copra drying—see Ref. 31).

31. Child, R., "Coconut Shells as an Industrial Raw Material. II. Miscellaneous Uses. Fuel", *Curr. Sci.*, 1944, **13**, 4–6. See this article for references 17–30, and the previous article (ref. 17. *Curr. Sci.*, 1943, **12**, 292–294), for references 1–16. 32. Child, R., "Ceylon's Coconut Crops", *Tropical Agriculturist* (*Ceylon*), 1939, **92**, 330–335. 33. *Review of Coconut Products for 1938.* Leo Schnurmacher, Inc., Manila, Commonwealth of the Philippines, 1939, 22. Table N. 34. Katharine Snodgrass, "*Copra and Coconut Oil*", *Fats and Oils Studies*, No. 2, Food Research Institute, Stanford University, California, April, 1928, Chapter III, 26–34. 35. International Institute of Agriculture. *Studies of Principal Agricultural Products on the World Market*, No. 4. *Oils and Fats: Production and International Trade*—Part I, (Rome, 1939), 165–199. 36. Herbert S. Walker., "The Coconut and its Relation to the Production of Coconut Oil', *Philippine J. Sci.*, 1906, **1**, 58–82. 37. Cooke, F.C., "The Relationship between Weights of Coconuts, Husked Nuts and 'Meat," *Malayan Agric. J.*, 1934, **22**, 539–40. 38. Pieris, W. V. D., "Studies on the Coconut Palm—II. On the Relation between the Weight of Husked Nuts and the Weight of Copra," *Tropical Agriculturist* (*Ceylon*), 1935, **85**, 208–20. 39. Park, M., "Some Notes on the Effect of Drought on the Yield of Coconut Palms", *Ibid.*, 1934, **83**, 141–150. 40. Child, R., "Coconut Shell Charcoal", *Coconut Research Scheme* (*Ceylon*) *Leaflet No. 6*, March 1940, pp. vii & 1 diagram. Reprinted in *Journal of Coconut Industries* (*Ceylon*), 1940, **4**, No. 2 (June), pp. 77–84, in *Travancore Economic Journal*, 1940, **19**, 573–78, and in *New Guinea Agricultural Gazette*, 1941, **7**, 61–65.

SIMILARITIES BETWEEN THE EXCITATION PHENOMENA IN UNSTRIATED MUSCLE AND THOSE IN THE RETINA

BY INDERJIT SINGH
(*Brigade Laboratory, Allahabad*)

THERE is a close resemblance between the excitation phenomena in unstriated muscle, and those in the retina; the resemblance may be superficial, but there is probably an underlying unity between excitation processes in tissues, which are physiologically widely divergent. The excitation phenomena in the retina described herein, are summarised from Hartridge (1941).

In unstriated muscle, there are two antagonistic excitabilities (Singh, 1938); there appear to be similar antagonistic excitabilities in the retina. This antagonism in the retinal response may be in the individual rods and cones, or in groups of rods and cones or may be in the nervous elements higher above. In unstriated muscle, these antagonistic excitabilities appear to be located in the individual muscle fibres, and it is quite possible, that in the retina, they are located in the individual cones and rods.

Adaptation and Fatigue.—In plain muscle, these two phenomena are identical. If the eye, after being in the dark, is rapidly exposed to light, it becomes light adapted. *Mytilus* muscle and frog stomach similarly become adapted to alternating current. In the eye fatigue to one colour, results in hyper-excitability to the complementary colour. In plain muscle too, adaptation and fatigue of one excitability results in hypersensitiveness to the antagonistic excitability; in *Mytilus* muscle, adaptation and fatigue to alternating current, results in hyper-excitability to potassium (Singh, 1944).

The After-Image and the A.C. Off-Contracture.—As a result of a stimulus the region of the retina affected gives a response which is followed by a second or after-image. During the after-image, the area is incapable of reacting with normal intensity to a like stimulus, but shows increased excitability to a stimulus of the opposite kind.

A corresponding phenomenon is seen in unstriated muscle. A contraction produced by alternating current or by increase in the osmotic pressure of the saline, is followed by an antagonistic contraction on cessation of the stimulus. On cessation of the current, the muscle is less responsive to it, but hyperexcitable to potassium, *i.e.*, excitable to the same stimulus, but hyperexcitable to stimulus of the opposite kind.

The after-image of the first impression is removed by the second impression. Similarly the A.C. off-contracture is neutralised by a second stimulation with alternating current.

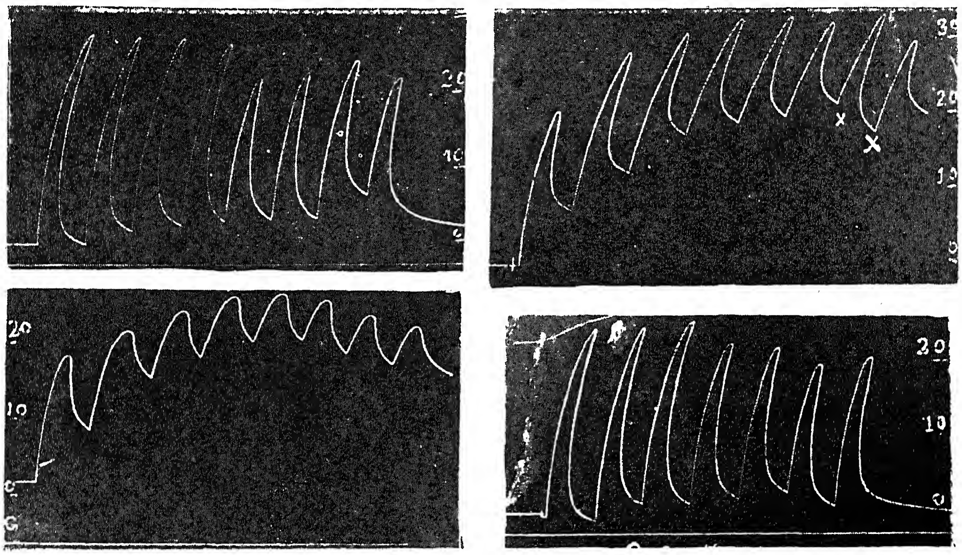
The duration of the after-image is found to correspond roughly with the intensity and duration of the stimulus; the magnitude of the A.C. off-contracture also corresponds with the intensity and duration of the alternating current.

Successive Contrast.—In the eye, after stimulation by one kind of source, another of a similar nature is inhibited, while that of a different nature is either unaffected or may be even increased. These results are very similar to those described in unstriated muscle. After stimulation with alternating current, the excitability to the current is depressed, and that to potassium may remain unaltered or may even be increased.

Simultaneous Contrast.—This appears to be due to extension of the after-image phenomenon into a region of retina outside the confines of the original stimulus. It would appear as if some substance is liberated in the stimulated area which diffuses into the neighbouring parts. This suggestion is very similar to the stimuli is required to produce fusion as high intensities than at low.

In plain muscle, the fusion is more complete if the successive stimuli are of low intensity or shorter duration (Fig. 1, *l.*). In *Mytilus* muscle a stimulus of very high intensity may act like a stimulus of low intensity. This is due to the fact that for stimulation, the muscle possesses an optimum voltage, so that high voltages become submaximal stimuli.

Plain muscle shows other phenomena of excitability shown by nerve structures. Thus the statement that a stimulus has two components, one excitatory and the other inhibitory (Singh, 1943), is analogous to the statement that in the nerve cells there are two antagonistic states, such as the central excitatory state and the central inhibitory state; the latter is identical with adaptation in unstriated muscle. The phenomenon of "rebound" after inhibition is well shown by plain muscle; those similar to subliminal fringe and occlusion are also found.



On the left; 1st fig. Stimulation of *Mytilus* muscle with A.C. 10V/10 sec. per min. 2nd fig. with A.C 5V/10 sec. per min.
On the right: 1st fig. A.C. 10V/3 sec. per min. 2nd fig. A.C. 10V/12 sec. per min.

one I have made regarding the A.C. off-contracture in plain muscle. The substance producing the contracture appears to diffuse away from the seat of action into the solution; in plain muscle, this substance may be potassium, and it is possible that potassium leaks from the stimulated cones into the surrounding areas. There is increased leakage of potassium from *Maia* Nerve during stimulation (Cowan, 1934), and corresponding gain of sodium by *Mytilus* muscle (Singh, 1939).

Flicker and Visual Persistence.—The persistence of the primary image after the cessation of the stimulus causes the stimuli to fuse to give a uniform sensation without flicker, which may be compared to complete tetanus of a muscle. In the eye, since the primary response is more abrupt, the greater the intensity of the stimulus, a more rapid rate of succession of

Discussion.—It would appear that the mechanisms of stimulation of the retina and plain muscle are very similar. It would then be legitimate to expect that there may be other analogies between the functioning of the two besides those given above. If cones like plain muscle have two antagonistic excitabilities, then they are stimulated by complementary colours. Like plain muscle some cones may be less excitable to both forms of stimulation, resulting in the cone mechanism being inactive, or the inexcitability may extend to certain parts of the spectrum, resulting in some form of colour blindness.

1. Cowan, S. L., *Proc. R. Soc.* B, 1934, **115**, 216. 2. Hartridge, H., *Starling's Principles of Human Physiology*, 1941, London. 3. Singh, I., *J. Physiol.*, 1938, **92**, 62; 1939, **96**, 1; *Proc. Ind. Acad. Sci.*, 1943, **17**, 20; 1944, **19**, 91.

LETTERS TO THE EDITOR

ON LINEAR ESTIMATION AND TESTING OF HYPOTHESIS

1. The object of the present note is to consider the most general problem in the theory of linear estimation and get suitable generalisations of Markoff's theorem and to derive suitable tests of significance connected with estimated functions.

2. There are n stochastic variates $T_1, T_2, \ldots T_n$ with the variance and covariance matrix $\Lambda = ((\lambda_{ij}))$ such that

$$E(T_i) = \theta_i = a_{i1}\tau_1 + a_{i2}\tau_2 + \ldots + a_{im}\tau_m \qquad (2\cdot1)$$

and m not necessarily less than n. Some of the τ's may be regression constants in which case their coefficients will be functions of concomitant variates. We want a linear function $L(T) = b_1T_1 - b_2T_2 + \ldots\ldots + b_nT_n$ such that $E\{L(T)\} = \theta = l_1\tau_1 + l_2\tau_2 + \ldots\ldots + l_m\tau_m$, a given parametric function and $V\{L(T)\}$ is minimum. If $L(T)$ can be found to possess such properties then it is called the best estimate of θ.

3. It has been shown that the set of equations

$$Q_i = L_i\Lambda^{-1}y' = \sum_{j=1}^{m} L_i\Lambda^{-1}L_j'\tau_i = h_i \qquad (3\cdot1)$$

$(i = 1, 2, .. m)$, where L_i and y are the row matrices $(a_{1i}, a_{2i}, \ldots a_{ni})$ and $(T_1, T_2, \ldots T_n)$ and the dash represents their transpose obtained by minimising

$$L = \Sigma\Sigma\, \lambda^{ij}\,(T_i - \theta_i)\,(T_j - \theta_j), \qquad (3\cdot2)$$

where λ^{ij} are the elements of Λ^{-1}, are such that Q_i is the best estimate of h_i and the best estimate of θ is given by $\Sigma\, c_i Q_i$ where c's are such that $\theta \equiv \Sigma\, c_i h_i$. If the rank of the matrix of the equations (3·1) is less than m, then all parametric functions are not estimable

4. The set of equations (3·1) possesses the following properties.

(i) Variance of Q_i is the coefficient of τ in the ith equation;

(ii) Covariance of Q_i and Q_j is the coefficient of τ_j in the ith equation;

(iii) If $\Sigma\, c_i Q_i \equiv 0$, then the parametric function $\Sigma\, c_i\tau_i$ is not estimable;

(iv) If $\Sigma\, a_i Q_i$ and $\Sigma\, b_i Q_i$ are the estimates of $\Sigma\, l_i\tau_i$ and $\Sigma\, m_i\tau_i$, then their variances and covariances are given by

$$\begin{pmatrix} \Sigma\, al & \Sigma\, bl \\ \Sigma\, am & \Sigma\, bm \end{pmatrix}$$

(v) The number of estimable parametric functions is equal to the number of functionally independent Q's.

(vi) An intrinsic property is that all the above five properties hold good even with a subset of the equations obtained by eliminating one or more τ's.

(vii) The best estimate of any estimable parametric function $\Sigma\, l\tau$ is unique and is obtained by substituting any particular solution for τ's obtained by solving the equations (3·1) or any set of equations derived from it; and so also the expressions for the variances and covariances.

5. If we want to test the hypothesis $\Sigma\, l\tau = \xi$ then we construct the statistic

$$w = \frac{\Sigma\, c\,Q - \xi}{\sqrt{\Sigma\, cl}},$$

where $\Sigma\, c\,Q$ is the estimate of $\Sigma\, l\tau$ and refer the normal tables for tests of significance. If we want to test the composite hypothesis $\Theta_i = \Sigma\, l_{ij}\tau_j = \xi_i$, $i = 1, 2, .. k$ we take a linear compound of these k relations

$$\Sigma\, \lambda_i\,(\Theta_i - \xi_i)$$

with the corresponding estimate

$$\Sigma\, \lambda_i\,(\Sigma\, c_{ij}Q_j - \xi_i) = \Sigma\, \lambda_i P_i$$

and variance $\Sigma \Sigma \lambda_i \lambda_j V_{ij}$ where $V_{ij} = \text{cov}(P_i P_j)$ and construct the above statistic

$$V = \frac{\Sigma \lambda_i P_i}{\sqrt{\Sigma\Sigma \lambda_i \lambda_j V_{ij}}}.$$

We choose the compounding coefficients such that V^2 is maximun. This leads to the determinental equation

$$|P_i P_j - V^2 V_{ij}| = 0.$$

The distribution of V^2 on the non-null hypothesis is obtained as

$$\text{Const}\cdot e^{-\frac{V^2}{2}} (V^2)^{\frac{k-1}{2}} I_{\frac{k}{2}}(V\phi)\, d V^2.$$

on the assumption that the y's form a multivariate normal system. The necessary statistics, when the variances and co-variances are not known are obtained by studentising the above statistics. Some of the important distributions will be discussed in a paper to be published in full elsewhere.

C. Radhakrishna Rao.

Statistical Laboratory,
Presidency College,
Calcutta.
April 4th, 1944.

ACTIVATION OF NITROGEN AT LIQUID AIR TEMPERATURE

The behaviour of active nitrogen is remarkable towards heat. The disappearance of its after-glow on heating, first noticed by Lord Rayleigh[1] has been found by us to be subject to the pressure conditions of the activated gas:[2] the quenching temperature is increased by an increase of the gas pressure.[2] Rayleigh also observed that if a stream of active nitrogen is led through a tube cooled by liquid air, the after-glow is quenched.[1] Our recent results show that the occurrence of this quenching also depends upon the magnitude of the gas pressure; when this last was raised above 40 mm., the glowing nitrogen escaped the *Rayleigh quenching* produced, at say 15 mm. under the same conditions.

Attempts were next made to minimise a possible insufficiency in the cooling of the gas at high pressures. The nitrogen was streamed through spirals, in all about 3 yards long, cooled by liquid air. The last spiral surrounded the Crooke's tube used for the nitrogen activation by electrical discharge. With the discharge tube under liquid air, it was remarkable to observe that the Rayleigh quenching of the nitrogen after-glow did not occur, at even such small pressures of about 1 mm., at which, under normal conditions, it was easily produced.

An interesting result was now observed when the gas pressure was reduced beyond 0·1 mm. An after-glow of 15-17 minutes' duration was produced; platinum and aluminium electrodes were used. Starting with fresh electrodes, both the intensity and duration of the after-glow increased markedly with repeated discharges. Results were in essence the same with pure nitrogen and with an admixture of 0·8 per cent. of oxygen, except for the fact that with the latter a greater number of discharges were necessary than with pure nitrogen, to produce this long after-glow; it was not observed if the gas pressure was reduced to that due to a Topler. This long after-glow could not be ascribed to activated vapour of mercury or that of the pump oil, since there were liquid air traps on either side of the discharge tube. Observations with a direct vision spectroscope showed that this long after-glow was a nitrogen emission; besides, it was not observed when the nitrogen was replaced by air, hydrogen or carbon dioxide, other conditions being unaltered. Cooling by liquid air during activation is more favourable than an elaborate pre-cooling before exposure to discharge, for the production of this long after-glow. That on the cessation of the discharge and after allowing the temperature of the system to rise, there ensues a sensible rise of pressure, suggests that a 'clean up' or adsorption of the nitrogen on the electrodes is a possible factor in the occurrence of this phenomenon.

Chemistry Department,
Benares Hindu University, S. S. Joshi.
May 10, 1944. A. Purushotham.

1. Strutt, R. J., *Proc. Roy. Soc.*, 1911, **A 85,** 219–29.
2. Joshi and Purushotham, *Proc. Ind. Acad. Sci.*, 1944, **A 19,** 159–62.

A SHORT NOTE ON THE INFRA TRAPS OF KOTAH STATE

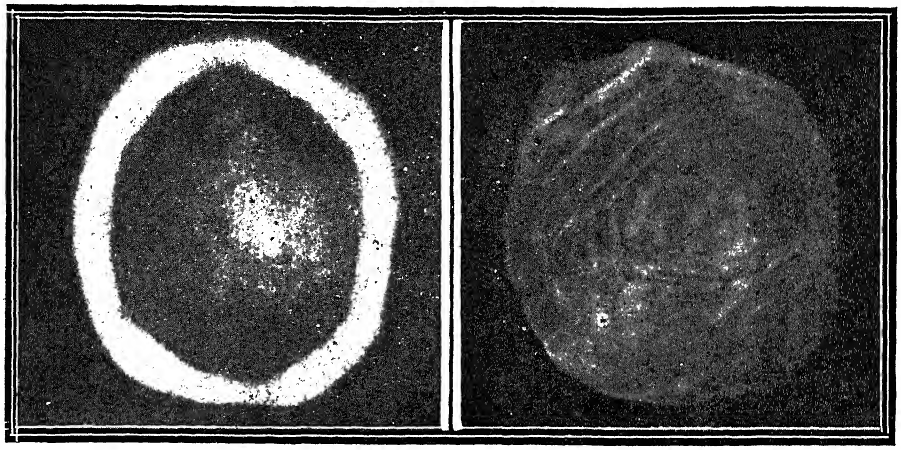
Recently the writers had been to Kotah State in connection with the mineral survey of the State. There they studied a formation which has been referred to and mapped as Infra Trap in the old G.S.I. map. This lies over the Vindhyans and is below the trap. Its thickness is much variable being from a few feet to about 100 feet. The formation consists of a hard cherty silicious rock probably formed by the deposition of the volcanic ash in the lakes existing at that time. It appears that the rocks of this formation were deposited just before the outpouring of the lava. In this formation the authors have found fossils, both animal and plant. The animal fossil probably seems to be the jaw of some reptilian group and the plant fossil showing sporo-carps, spores, etc., are probably of the Marsiliaceæ group. As far as the authors are aware this is the first locality where the fossils have been found just below the trap in Rajputana. The fauna and flora revealed are quite interesting. Detailed work is going on and the results will be published later.

Benares Hindu University, V. S. Dubey.
April 27, 1944. Y. K. Agrawal.

X-RAY TOPOGRAPHS OF DIAMOND

In a recent paper[1] published by the Indian Academy of Sciences, and included in a Symposium on the Structure and Properties of Diamond, the author described a method by which any variations in the reflecting power of the lattice planes for X-rays which may exist over the area of a cleavage plate of diamond may be rendered evident. The technique of the crystal can be obtained. Some 18 topographs of this kind were reproduced in the paper. Unfortunately, however, in obtaining these, duplitized X-ray films were employed with the result that there was a certain amount of blurring, and much of the detail was lost. It has since been found that greatly improved results are obtained by using photographic plates instead of films.

The remarkable relationship that exists be-



Luminescence Pattern X-Ray Topograph

FIG. 1. Luminescence Pattern and X-Ray Topograph of D 188

Birefringence Pattern X-Ray Topograph

FIG. 2. Birefringence Pattern and X-Ray Topograph of D 181

employed is based on the use of white X-radiation diverging from a pinhole, and thus giving a Laue reflection at a chosen set of lattice planes. By suitably tilting the crystal and the photographic film, a practically undistorted reproduction, or "X-ray topograph" tween the X-ray topographs and the other patterns, such as the luminescence, the birefringence and the ultra-violet transparency patterns are best appreciated only when they are set side by side, with all the pictures enlarged to the same size, and arranged in the

same orientation. Since this is scarcely possible in the publication quoted above, two typical topographs of diamonds D188 and D181 are reproduced in Figs. 1 and 2 above, together with the corresponding luminescence pattern of the former, and the birefringence pattern of the latter, which were taken by Mr. G. R. Rendall. The topograph of D188 was taken with the new technique, and shows fine detail. A comparison of these patterns reveals the remarkable similarity that exists between them.

Department of Physics,
Indian Institute of Science,
Bangalore, G. N. RAMACHANDRAN.
June 14, 1944.

1. Ramachandran, G. N., *Proc. Ind. Acad. Sci.*, 1944, **A19**, 280.

RUTPURE OF WATER DROPS FALLING ON LIQUID SURFACES

THE present note contains preliminary observations on the rupture of water drops falling on liquid surfaces. Water drops of different sizes were allowed to fall from gradually increasing heights upon an oil surface. Observations show that for a given oil and for a given size of water drops, rupture takes place only when the drops fall from heights greater than a critical value.

An elegant method would no doubt be to study the phenomenon of rupture with the aid of high speed photography, recently developed to a considerable degree of perfection by H. E. Edgerton. In the absence of such a technique in this laboratory, only visual observations were made.

In the present investigation, kerosene, transformer oil and olive oil were employed. It was found that in the case of each oil mgh was nearly found to be constant, where m is the mass of the drop, g the acceleration due to gravity and h the critical height. The kinetic energy with which the drop should fall on the oil surface, in order that rupture may take place, should be greater than a critical value. This critical energy for a given drop varies with the nature of the oil and is probably connected with its surface tension and viscosity.

The critical energies for a drop of mass 0·825 gm. when falling upon kerosene, transformer oil and olive oil were found to be 240, 260 and 320 ergs respectively. The greater the viscosity of the oil, the larger is the value of the critical energy.

Further work is in progress and it is hoped to determine exactly the factors controlling the rupture of the drops.

Physics Laboratory,
Science College,
Patna,
April 14, 1944.

B. N. SINGH.
S. P. SINHA.

1. *Flash*, by Edgerton and J. R. Killian (Hale Cushman and Flint, Boston), 1939.

ETHYL ALCOHOL AS A SOLVENT FOR MODIFIED ROMANOWSKY STAINS

THE first worker to make use of a solvent other than water for dissolving the precipitate of compound stain produced by mixing methylene blue with eosin was Jenner (1899) who used methyl alcohol for this purpose. But since he did not use polychrome methylene blue for the preparation of his stain powder, therefore, his stain lacked the nuclear staining principle of Nocht's (1898) modified Romanowsky stain. Combining of Jenner's technique with Nocht's was taken up independently by Reuter (1901) and Leishman (1901). Reuter used absolute ethyl alcohol with aniline oil as the solvent whereas Leishman used the original methyl alcohol (Merck's "for analysis") of Jenner. But since in case of Reuter's technique a separate process of film fixation was always necessary, therefore his method did not become popular with people who preferred Leishman's method of fixing and staining in a single operation.

Since that date, all blood stains are, in general, modifications of the original Leishman's stain. Some of them, like Wright's and Wilson's stains, differing only in detail, whereas others, like Giemsa's and MacNeal's tetrachrome stains, are slightly different in composition. The solvent used for the preparation of solutions from these stains is, however, the same methyl alcohol as was originally used by Jenner or Leishman.

The difficulty in obtaining supplies of neutral acetone-free absolute methyl alcohol at reasonable prices for the preparation of blood stains led us to try experiments with a view to find out if absolute ethyl alcohol could be used in place of the expensive acetone-free methyl alcohol. As a result of these experiments we have seen that absolute ethyl alcohol can be safely substituted for the expensive methyl alcohol in the preparation of Leishman and Giemsa solutions. Ethyl alcohol, in fact, was found to possess a marked advantage over methyl alcohol when staining was to be done at higher atmospheric temperatures. Methyl alcohol being more volatile always gave a deposit of the stain on the film, but preparations with ethyl alcohol were free from this defect.

Various solutions of Leishman and Giemsa stains prepared with absolute ethyl alcohol were repeatedly tested for the staining of malarial blood. The technique followed being identical with the original formulæ of Leishman and Giemsa. In no case preparations inferior to those obtained with solutions containing methyl alcohol were obtained. In case of Giemsa solution, where fixation of thin smears is done separately and that of thick smears is unnecessary, the ordinary lime-distilled rectified spirit gave excellent results.

In view of the above results we are inclined to believe that:—

(1) The use of expensive acetone-free methyl alcohol for the preparation of blood stains as specified in literature is only incidental and not very necessary.

(2) Absolute ethyl alcohol can be a good substitute for the expensive acetone-free methyl alcohol in the preparation of stain solutions required for simultaneous fixation and staining of blood films.

(3) Even 95 per cent. alcohol can be used in the preparation of solutions of Giemsa type where fixation of thin smears is done separately and that of thick smears is unnecessary.

(4) Ethyl alcohol, in the preparation of Leishman type solutions for staining at higher atmospheric temperatures, is definitely superior in use to the volatile methyl alcohol.

My best thanks are due to Prof. J. N. Ray, Director of Drugs and Dressings, for his kind interest in the work.

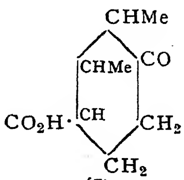
Central Research Institute,
Kasauli, and
Drugs & Dressings Directorate,
Directorate-General of Supply,
New Delhi,
B. S. Roy.
April, 24, 1944.

1. Jenner, L., *Lancet*, 1899, Pt. I, **370**. 2. Leishman, *Brit. Med. J.*, 1901, Pt. II, 757. 3. Nocht, *Centbl. f. Bakt.*, *I. Abt.*, 1898, **24**, 839. 4. Reuter, *Ibid.*, 1901, **30**, 249.

REARRANGEMENT OF SANTENONE-QUINONE

Samuel and Manasse[1] found that camphorquinone on treatment with concentrated sulphuric acid undergoes molecular rearrangement to give a keto-acid, $C_{10}H_{16}O_3$, which has been definitely shown by Simonsen and his co-workers,[2] to be 2:2:3-trimethyl*cyclo*hexan-1-one-4-carboxylic acid. It has now been found that *dl*-santenonequinone[3,4] (prepared by the oxidation of santenone with selenium dioxide), under precisely similar conditions, furnishes 2:3-*dimethyl*cyclo*hexan-1-one-4-carboxylic acid* (I), m.p. 132° (*semicarbazone*, m.p. 191°). The structure of the ketonic acid has been proved by degradation and by synthesis.

In the first instance, it has been found that this keto-acid on oxidation with nitric acid furnishes a tribasic acid, m.p. 181-82°, identical with a sample of *α-methylbutane-αβδ-tricarboxylic acid* (II), prepared by the condensation of ethyl β-chloropropionate with ethyl α-cyano-β-methylsuccinate[5] in presence of sodium ethoxide followed by hydrolysis of the resulting product. The formation of an acid of structure (II) by oxidation can readily be explained on the basis of structure (I) for the keto-acid.



(I)

$CO_2H\cdot CHMe\cdot CH(CO_2H)CH_2\cdot CH_2\cdot CO_2H$

(II)

The keto-acid itself has been synthesised by a simple and unambiguous method as follows: Ethyl αβ-dimethylacrylate has been condensed with ethyl cyanoacetate in presence of sodium ethoxide in the usual manner. The resulting sodio-salt reacts quantitatively with ethyl-β-chloropropionate to give ethyl γ-cyano-αβ-dimethyl*pentane-αγε-tricarboxylate*, b.p. 200-204°/6 mm., which on hydrolysis and subsequent esterification furnishes *ethyl αβ-dimethylpentane-αγε-tricarboxylate*, b.p. 178°/7 mm. The triethyl ester on cyclisation with finely divided sodium yields *ethyl 2:3-dimethyl*cyclo*hexan-1-one-4:6-dicarboxylate*, b.p. 170°/8 mm. 2:3-*Dimethyl*cyclo-*hexan-1-one-4-carboxylic acid* (I), m.p. 132° (semicarbazone, m.p. 191°) as obtained by hydrolysis of the above ketonic ester has been found to be identical with the ketonic acid formed by the rearrangement of santenonequinone.

My grateful thanks are due to Dr. J. C. Bardhan for the facilities offered to me and for his kind advice and criticism.

University College of
Science and Technology,
Calcutta,
Ram Narayan Chakravarti.
March 20, 1944.

1. *Ber.*, 1897, **30**, 3157; 1902, **35**, 3831. 2. Gibson and Simonsen, *J. Chem. Soc.*, 1925, **127**, 1295; Bhagavat and Simonsen, *Ibid.*, 1927, **131**, 77. 3. Semmler and Bartelt, *Ber.*, **41**, 125. 4. Palmén, *Finska Kemistamfundets Medd.*, **36**, 11–21. 5. Bone and Sprankling, *J. Chem. Soc.*, 1899, **75**, 853.

THE OCCURRENCE AND INHERITANCE OF A NEW TYPE OF HAIRINESS IN ASIATIC COTTONS

Apart from the degree of hairiness ranging from glabrous to a densely hairy plant-body, there is variation in the type of hairs on the cotton plant. Youngman and Pande[1] in their study of the epidermal outgrowths in the genera *Thespesia* and *Gossypium* describe two types of hairs, (*i*) the single hair-unicellular outgrowths and (*ii*) the stellate hair which originates from tufts of several cells fused at their bases.

A microscopical examination of hairiness in a large number of cotton types both *arboreum* and *herbaceum* at Indore has shown that both the types of hair, single and stellate, are present in all the types but while the single hair

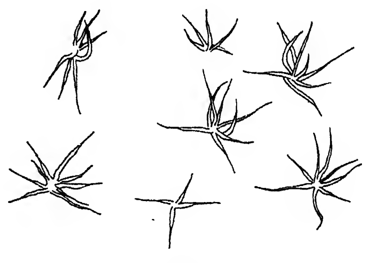


Fig. 1

is distributed all over the plant-body the stellate hair is mostly confined to the foliar organs, leaves, bractioles and petals. The number of rays in the stellate hair varies from 2 to 12, the most common number being 8 for *arboreums* and 6 for the *herbaceums* (Fig. 1). The length of the hair is generally found to be longer in the *herbaceum* than in the *arboreum*. In *G. tomentosum* which has a characteristic dense hairiness, the effect of gene H^{to}, Harland,[2] the hairs are all stellate with 8 rays interspersed occasionally with stellate hairs of larger number of rays in addition to single hairs to be found mainly on the leaf veins.

A new type of stellate hair (Fig. 2) has now been discovered in a *herbaceum* mutant, Viramgam lintless, where the stellate hair has

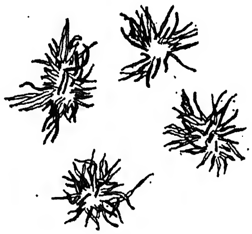


FIG. 2

20-30 short rays as against 2-12 found in other types. The distribution of this type of stellate hair over the plant-body is the same as in the ordinary stellate type. This hair gives the plant organs a characteristic waxy appearance. The leaves have a gritty feel and on rubbing with the fingers the grit comes off easily. This type of hairiness has so far not been met with in any other cotton. It may be mentioned here that this stellate hair does not

FIG. 3

correspond to the peltate scale of *Thespesia* described by Youngman. Whereas the rays of the stellate hair are free almost to four-fifths of their length, in *Thespesia* the rays are fused almost the whole length with the ends only free.

Evidence is here presented to show that this new type of stellate hair is due to a single gene designated H^{vi} and it is recessive to the normal hair and that this gene is independent of the lintless gene *lid* (Govande)[3] of Viramgam lintless in its inheritance.

This new type had been crossed with three other types mentioned below mainly for studying the inheritance of lintlessness and incidentally the behaviour of the stellate hair was recorded in the F_1's and F_2's.

Types	Species
1. Wagad lintless	*G. herbaceum* var. *frutescens*
2. Nandyal lintless	*G. arboreum* var. *typicum* forma *indica*
and 3. N_6.	A synthetic multiple recessive

The F_1's, ratoons of last year (the observation was not made in the first crop) do not show any marked difference from the normal except that they appear a little more pubescent than the parents. Examination of the leaves under the microscope showed the normal stellate hairs with 6-8 rays somewhat longer than in the Viramgam lintless parent with occasional hairs having 12-16 rays. There was clear segregation for the type of stellate hair in the F_2 even for naked eye but two leaves of each plant were examined under the microscope and scored, keeping the normal and F_1 type together as the separation between the two was rather difficult, the main difference between the two being in the number of rays.

	Segregation			
	Normal	Viramgam Stellate	Total	X^2 3:1
1. Viramgam lintless × Wagad lintless	133	69	169	1·23
2. Viramgam lintless × Nandyal lintless	101	28	129	0·75
3. Viramgam lintless × N_6.	70	15	85	2·45

The fit is not bad although in all the three crosses there is a consistent excess of the normal. There could, however, be little doubt about a single gene difference. Plants typical of the Viramgam stellate type were recovered only in the cross between the two herbaceums, Viramgam lintless × Wagad lintless, whereas in the other two crosses, interspecific, the stellate type was modified to a certain extent in that the number of rays of the stellate hair was slightly reduced, about 20 only, and the rays were also slightly longer than in the Viramgam type.

The two crosses, Viramgam lintless × Wagad lintless and Viramgam lintless × Nandyal lintless have not produced any bolls yet but the cross Viramgam lintless × N_6 has started producing bolls nine months after sowing.

Examination of the bolls in the last cross has shown that some of the plants with the Viramgam stellate hair are linted and that some of the lintless segregates have normal hairs, indicating that the lintness gene *lid* is independent of H^{vi} in its inheritance.

The work here reported was conducted as part of the Cotton Genetics Research Scheme, Indore, financed by the Indian Central Cotton Committee. We are indebted to Mr. P. D. Gadkari who made the Viramgam lintless crosses when he was at Indore.

Institute of Plant Industry,
Indore, C.I., K. RAMIAH.
May 1944. V. N. PARANJPE.

1. Youngman, W., and Pande, S. S., 'Epidermal outgrowths of the genera *Thespesia* and *Gossypium*," *Annals of Botany*, 1929, **43**, 711. 2. Harland, S. C., *Genetics of Cotton*, Jonathan Cape, 1939, 84. 3. Govande, G. K., 'A new gene for lintlessness in Asiatic cottons," *Curr. Sci.*, 1944, **13**.

STUDIES ON THE PHYSIOLOGY OF MUSTARD

A NUMBER of experiments on the fundamental aspects of the physiology of growth and development, with reference to time of flowering and fruiting of mustard plant was devised with selected varieties of the Agricultural Department, Bengal, Tori No. 7 and Rai No. 5 in pots with five replicates and twenty individuals in each case and the results are reported below.

(1) *Effect of time of sowing.*—Sowings of the two varieties at interval of 15 days commencing from 1-9-'43 to 15-11-'43 were investigated.

In Tori, the flowering time for the five sowings varied between 16 and 20 days and the time of fruiting between 24 and 28 days. There is thus no significant effect of the time of sowing on the time of flowering and fruiting, though it is evident that temperature, humidity and length of day gradually decreased as the sowing time was delayed. It was, however, found that all plants sown on 1-9-'43 and 20 per cent. of those sown on 16-9-'43 failed to set seed.

In Rai for the six sowings on 1-9-'43 and the subsequent dates the times of flowering were 46, 44, 34, 26, 27, 27 days and the times of fruiting 55, 55, 43, 40, 39 and 38 days. It is thus seen that the vegetative period gradually shortened from 46 to 27 days from the first to the fourth sowing and then remained more or less constant in the last three sowings.

(2) *Photoperiodic effect.*—To study the effect of length of day on flowering and fruiting time, two sets of experiments were devised. In the first set with the two varieties, sown on 16-9-'43 plants were exposed to 14 hours and 10 hours light period when the control were exposed to normal daylight which gradually decreased from 12 hrs. 15 mins. to 11 hrs. 26 mins. The prolongation of light period was done by exposing the plants to electric light from a 100 c.p. bulb in a chamber at a distance of 5 feet from the pots, after sunset for the additional period and the shortening was done by taking the pots in a dark chamber for the required period before sunset and then brought out. It was found that with 14 hours the flowering time was 42 days and with 10 hours 53 days against 44 days in the control for Rai and for Tori the flowering time was 20 days for 14 hours, 22 days for 10 hours and 20 days for the control. It is thus seen that in Rai the shortening of light period prolonged the vegetative phase and for Tori the effect is negligible.

The second set was therefore designed with Rai only. Sown on 15-11-'43 and the light period used were 16 hours, 14 hours, 10 hours and 8 hours as against control where the light period gradually decreased from 10 hrs. 56 mins. to 10 hrs. 36 mins. The flowering time was 24 days for 16 hours, 26 days for 14 hours, 33 days for 10 hours and 47 days for 8 hours as against 27 days in the control. Shortening the light period thus shows a lengthening of the vegetative period in this set also though the actual flowering time in light periods common to both sets was much greater in the first set.

In the experiment on photoperiodism it is found by a comparison of the two sets of experiments with Rai sown on 16-9-'43 and 15-11-'43 that in the second set the vegetative periods were shorter than those in the first set for the same light periods used. In the time of sowing experiments also the flowering time became gradually shortened with lateness of sowing, though according to the photoperiodic effect recorded for Rai, the flowering time should have become gradually longer as the daily light period gradually decreased with lateness of sowing from 12 hrs. 34 mins. to 10 hrs. 35 mins.

It is, however, seen that the temperature gradually decreases from September to December the monthly mean temperatures for September, October, November and December being 29·2° C., 28·5° C., 24·0° C. and 21·4° C. It appears, therefore, that the vegetative period shortens with lower temperature, but for the sowings on 15-10-'43, 1-11-'43 and 15-11-'43, it is more or less the same. It seems thus that 24-27 days is about the minimum vegetative period which is not further decreased either by lower temperature or by longer photoperiod under conditions of the experiment.

Thus it may be concluded that a longer vegetative period in the first set of photoperiodic experiments and a gradual decrease in flowering time in case of time of sowing experiments is due to the vegetative period being shortened with decrease of temperature. Under conditions of experiment of the two varieties studied the time of flowering in Tori seems to be practically indifferent to light period and to the time of sowing, though Rai shows a lengthening of vegetative period with the shortening of the light period and a greater shortening of the vegetative period is observed with increased temperature range and this confirms Sen and Chakrabarty's findings (1942). In the time of sowing experi-

ment the expected photoperiodic effect in Rai, due to shortening of day length is, however, seen to be counterbalanced by low temperature effect.

(3) *Vernalization*.—Soaked unsprouted seeds of both the varieties were exposed to 2-4° C. in a refrigerator for 10, 20 and 30 days and sown on 1-10-'43 with controls. The flowering time for the control, and 10, 20, 30 days vernalized sets were 34, 33, 30 and 30 days and the fruiting time 43, 38, 38, 38 days respectively for Rai and the flowering time were 18, 18, 17, 15 days and the fruiting time 26, 25, 23 and 24 days respectively for Tori. Tori thus seems to be indifferent in the flowering and fruiting time due to presowing low temperature treatment and in Rai in view of the variation between plants within each treatment the differences in flowering and fruiting time are not significant.

Sen and Chakrabarty (1942) in the course of their intensive investigations over a number of years have reported a clear earliness of flowering in mustard due to presowing low temperature treatments. The results reported here do not confirm their findings, but it should be remembered that the varieties used by them and the authors are not the same and the post-treatment environmental factors in Almora and Calcutta are distinctly different.

It is thus seen that for any conclusion arrived at, after vernalization studies, the variety and the post-treatment environmental conditions should always be taken into account.

Botany Department,
Presidency College,
Calcutta,
May 6, 1944.

J. C. Sen Gupta.
Nirad Kumar Sen.

1. Sen, B., and Chakrabarty, S. C., *Ind. Jour. Agr. Sci.*, **1938**. 2. —, *Ibid.*, **1942**.

TRICHODINA SP. FROM THE CAPSULAR GLAND OF *ARIOPHANTA LIGULATA* (FER.)

Dasen[1] in his account of the reproductive system of *Ariophanta ligulata* (Fer.), states that "in the cavity of the 'capsular gland' are found lying freely great numbers of very complex bodies which appear to be extrusions from the glandular wall". In the course of my studies of the reproductive system of some South Indian Pulmonates with special reference to the formation of the spermatophore, I had the opportunity of examining in detail the contents of the capsular gland of *Ariophanta ligulata*, and I find that what Dasen[1] considered to be 'excretory corpuscles' are really Peritrichous ciliate parasites belonging to the genus *Trichodina*. The two sketches given here illustrate the structure of the *Trichodina* found in *Ariophanta ligulata*. Dasen[1] does not seem to have examined the contents of the capsular gland of living specimens of *Ariophanta ligulata*. Had he done so, he would have noticed the so-called 'excretory corpuscles' swimming rapidly with their cilia.

The shape of the *Trichodina* from *Ariophanta ligulata* is best made out in living specimens. Dasen[1] described the 'excretory corpuscles' as resembling 'a finger bowl'. In the living specimen, with the velum extending all round the base, the shape resembles that of a hat, and is intermediate between that of *Trichodina pediculus*, and *Trichodina urinicola*.

A sketch of the basal view of the specimen is given by Dasen,[1] but he mistook the denticulated ring for a 'twisted rope'. As may be seen from the sketches given below, the organisation is typical of *Trichodina*. There is a well developed basal disc, velum, and denticulated ring. The denticulated ring contains about 19 teeth. In *Trichodina pediculus*, Clark[2] states that there are 24 teeth. The meganucleus is horse-shoe shaped and the micronucleus, which is not seen in the view represented in the figures, is imbedded in the meganucleus.

The incidence of the parasite in the capsular gland of *Ariophanta ligulata* seems to vary in the different seasons and also with the locality from which the snails are collected.

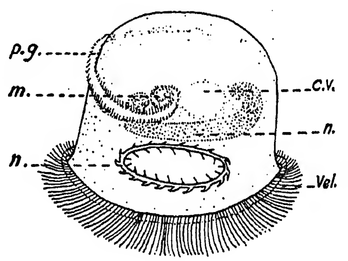


Fig. 1. *Trichodina* sp. from *Ariophanta ligulata* (Fer.), side view. *c.v.*, contractile vacuole; *m.*, mouth; *n.*, meganucleus; *p.g.*, peristomial groove; *r.*, denticulated ring at inner end of basal disc; *vel.*, velum.

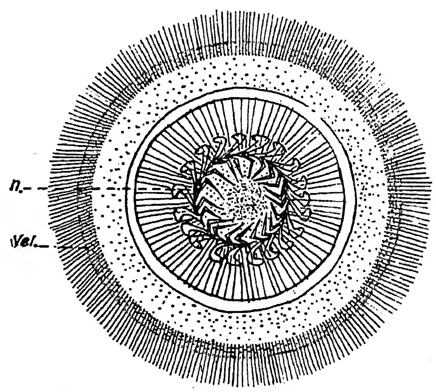


Fig. 2. *Trichodina* sp., from *Ariophanta ligulata* (Fer.), basal view. *r.*, denticulated ring at inner end of basal disc; *vel.*, velum.

From August to November I was able to collect large numbers of the parasites. In the subsequent months I found only few parasites and mostly in the encysted condition. In specimens which were obtained from Madras

the parasites were as a rule much less abundant than those from Nellore District. I may also mention that these parasites are not found in *Ariophanta bistralis* (Beck.).

Bhatia[3] states that the family Urceolariidæ, to which *Trichodina* belongs, has not been recorded so far from India. But Dr. H. S. Rao[4] in his paper on a Brackish-water Actinian. *Pelocoetes* from Madras mentioned the occurrence of *Trochodina* sp. in large numbers in the gastrovascular cavity and often swarming in the cavities of the tentacles.

It is, however, very interesting that species of *Trichodina* should occur in a land animal like *Ariophanta ligulata*. *Trichodina pediculus*, the best known species of *Trichodina* occurs on the body surface of *Hydra*. *Trichodina urinicola* has been found in the urinary bladder of a moribund toad and also in the newt *Triturus*, in the same site. Other species of *Trichodina* have been collected from bodies and gills of fish. Discussing the life-histories of ciliate parasites. Goodrich[5] states: "Fulton suggested that *Trichodina urinicola* may have evolved from forms like *Trichodina pediculus* infesting fish-like ancestors; the ciliates leaving the gills and body surface for the bladder as or before the host left the water". But this theory will not explain the origin of a species of *Trichodina* inhabiting the reproductive system of a land Pulmonate like *Ariophanta ligulata*.

In conclusion I have pleasure in expressing my thanks to Prof. R. V. Seshaiya for guidance and encouragement and to Dr. H. S. Rao for pointing out that a species of *Trichodina* was recorded by him.

Zoology Department,
Annamalai University,
Annamalainagar, P. N. Rajakrishna Menon.
March 30, 1944.

1. Basen, D D., *Proc. Zool. Soc. London*, 1933, **103**, 97. 2. James-Clark, H., *Ann. and Mag. Nat. Hist.*, 1866, **17**, 401–25. 3. Bhatia, B. L., "Fauna of British India," *Protozoa: Ciliophora*, 1936, 395. 4. Rao, H. Srinivasa, *Journ. and Proc. As. Soc. Bengal* (n.s.), 1924, **20**, 344. 5. Goodrich, H. Pixell, 'Life-Cycles of Certain Infusoria with Observations on Specificity in Parasitic Protoza.' in *Evolution* (edited by DeBeer, G. R.), 1938, pp. 231-34.

BURNT PADDY-HUSK FOR THE CONTROL OF INSECTS IN STORED FOOD GRAINS

Recent investigations by Briscoe,[1] Parkin[2] and others have shown that certain kinds of finely-ground dusts of natural minerals like Flint, Felspar, Silica, Dolomite and Limonite and flue dusts from power stations and blast furnaces and power-station Clinker, act as very efficient checks against weevils infesting wheat when the dusts are mixed intimately with the grain.

Observations made by the senior author, of the methods of storing grains, followed in the interior villages of the Malnad areas, led to an investigation of the efficacy of burnt paddy husk in the control of insects affecting different grains. It was found that burnt paddy husk, in finely powdered form (100-mesh to the inch), when thoroughly mixed with jola, rice, wheat and horse-gram at the rate of 1 per cent. of the weight of the grains, adhered to them exceedingly well and caused a high percentage of mortality of the insects. In a series of experiments, in Petri dishes, jars and gunny bags (holding one seer of grain) the following rates of mortality were observed:—

Grain	Insect	Average percentage of mortality
1. Jola ..	Weevil: *Calandra oryzæ*	86·3
2. Rice } 3. Wheat } ..	Beetle: (*a*) *Rhizopertha dominica*	100·0
	(*b*, *Tribolium* sps.	68·4
4. Horsegram	Beetle: *Bruchus chinensis*	100·0

The larval stages of *Tribolium* and *Bruchus* beetles in their tunnels inside the grains, have also been found to be affected. Sound grains (free of insects) mixed with burnt paddy husk powder, also repelled the insects to a marked degree.

The removal of the powder from the grains offered no special difficulty, since, ordinary winnowing and sieving and the usual cleaning or moistening with water prior to cooking for consumption, are found sufficient to render the grains free of the powder.

As paddy husk is commonly available everywhere, its use makes the problem of control of insects affecting stored-grains very easy, cheap and simple. The chances of 'silicosis' in the use of this powder, are very much less than in the case of the powders of pure minerals and 'clinker'.

Further work on a large scale is in progress. Fine powders of burnt husk of other cereals and some pulses are also being tested.

Department of Agriculture,
Bangalore, M. J. Narasimhan.
June 14, 1944. B. Krishna Murthy.

1. Briscoe, H. A. V., "Some New Properties of Inorganic Dusts," *J. Roy. Soc. Arts*, **91**, (4650). 2. Parkin, E. A., "Control of the Granary Weevil with Finely Ground Mineral Dusts," *Ann. Appl. Biol.*, March 1944, **3**, No. 1.

RELIEF FOR SCIENCE TEACHERS

The appalling position of science teachers, particularly of those serving in non-Government institutions, whose emoluments even during peace-time were hardly adequate for their sustenance, has been brought home through an ever-increasing number of letters which reach me daily from all parts of India.

A large majority of them are ill-paid and do not receive even the meagre "Dearness Allowance" to which their less unfortunate brethren in Government employ are entitled. Their position which has always been acute, has become distressing since the beginning of 1943 due to racketeering in prices of foodstuffs and rents and the picture of pauperism aggravated by extortionate merchants and landlords, presented in these letters, has impelled me to come out into the open and appeal to the philanthropic public to come to their relief.

The position of the school teachers is rendered lamentable in view of the circumstance that no organization exists in this country to bring their case to the attention of the public. The tragedy is that nobody thinks of them; nobody knows that they need help. What is in fact, a front line tragedy, remains scandalously neglected, even unnoticed. The need for bringing them succour is no less urgent, no less pressing, than, for instance, for the working journalists; but there is no organization like the All-India Newspaper Editors' Conference, to espouse their cause.

Humanitarian considerations demand that the lot of the school teachers should be alleviated. Teaching is one of the most ancient and noblest professions and the teacher fulfils a very important and vital role in the body politic. During the war years, the teachers, particularly the science teachers, have trained a large number of students to man the fighting services, the ordnance factories and industrial establishments. Is it too much to hope that in this country, where charity to the deserving is enjoined on every citizen as a religious duty, the industrialists and philanthropic trusts would come forward for relieving the suffering of the teachers, who are on the brink of destitution?

I am enclosing herewith a representative letter* which I have received from one of my old pupils, Mr. Dhirendra Mohan Mukherji, which will lend support to what I have expressed in the letter. I hope you will give your closest attention to this question and see if a plan could be evolved to give some relief to the poor science teachers.

Office of the Council of Scientific
and Industrial Research,
Delhi, S. S. Bhatnagar.
June 1, 1944.

* Extracts from the letter referred to above.

"I do not know whether you are aware of the fact that for more than a year and a half the teachers of non-Government colleges in Bengal are engaged in a mute struggle to save their prestige as teachers. For obvious reasons they cannot go about stating their adverse conditions and begging for private or public help. If some of them have received any dearness allowance it is so meagre and so disproportionate with the manifold rise in the price of essential commodities that they are finding it increasingly difficult to maintain themselves and their families on their petty pre-war salaries.

The Government of Bengal have not found it possible to help in any way the teachers of non-Government colleges. The political organizations have not extended their help to those poor educators of young minds.

Apart from any humanitarian considerations these teachers, especially those of scientific subjects, have a right to live in British India because they are steadily supplying a good number of workers for the ordnance factories and other industrial organizations directly connected with the war effort.

The day is fast approaching when most of these science teachers will have to face starvation. Would it not be a matter of disgrace on the part of the renowned Indian Scientists if they fail to move in an attempt to bring relief to these honest teachers?"

CYCLEWELDING—A NEW BONDING PROCESS

Perfection of a new process, called "Cycleweld adhesive process", that will stick structural parts more firmly together than they can now be riveted or spot-welded, represents the successful culmination of a joint venture of two United States firms, the Goodyear Company and the Chrysler Motors Corporation. It is expected to speed up production as well as to simplify the manufacture of structural parts. While its present application is expected to be chiefly in the aviation field, many post-war uses are anticipated for it.

The Cycleweld adhesive process has two types of application. One is to bond vulcanised or synthetic rubber to metals or plastics. The other is to bond metal to metal, wood or plastics. It is the bonding of metal to metal that is most important at the moment. In both cases, the process is essentially the same and depends upon the use of newly developed cements, the composition of which is being kept secret for the time being. The proper cement is applied to the surfaces to be bonded together and "cured" in a suitable furnace under considerable heat and pressure. In the case of the metal to metal bond, the cement has been developed into the form of a film or tape. It is merely necessary to place this tape between the parts to be bonded together and then apply heat and pressure. The process of bonding metal to metal lends itself particularly to the bonding of light sheet alloy parts such as aircraft parts made from aluminium or magnesium alloys.

In comparison with riveting and spot-welding, cyclewelding shows both superior strength under static load and in resistance to vibrational stresses. In every use of cyclewelding, whether metal is being bonded to metal, or synthetic rubber to plastic, the result is a bond stronger than the materials bonded together. Post-war uses foreseen for the Cycleweld adhesive process include the making of composite articles of metals and plastics and the sheeting of wood with thin corrosion-resistant metals for the manufacture of automobile bodies, furniture, houses, etc.

REVIEWS

A Shorter History of Science. By Sir William Cecil Dampier (formerly Whetham), F.R.S. (Cambridge University Press) 1944. Pp. 189. Price 7*sh.* 6*d.* net.

This admirable booklet should reach the hands of all science students and mature middle-brows intent on filling a probably wide gap in their general knowledge. The structure and behaviour of matter are second in importance only to the spirit infusing them; and it is the wonderful fabric of modern science, patiently woven throughout the ages from religious beliefs, pagan philosophies, ingenious theories and crucial experiments that the author presents in close pattern: An expanding universe, for "science did not germinate and grow on an open and healthy prairie of ignorance, but in a noisome jungle of magic and superstition, which again and again choked the seedlings of knowledge." (p. 5).

It is not reasonable in war-time to expect so compendious a work to be slip-free. Robert Boyle (1627-91) was "the father of modern chemistry and brother to the Earl of Cork", not uncle (p. 65), for he predeceased his older brother, the second earl (1612-98). The names of the two French chemists, C. L. Berthollet (1748-1822) and M. P. E. Berthelot (1827-1907) have confused others before the author, who succumbs to this notorious trap by recording both as "Bertholet" (pp. 104, 108), indexing one only. Whilst the rare gases of the atmosphere are duly catalogued, it seems a pity that Ramsay and Rayleigh should be missing from an excellent index which embraces Venus and Adonis.

These, however, are only trifling blemishes in a thoroughly commendable introduction to a vast subject, whose importance to mankind grows with each enlargement of its frontier. They are mentioned in the hope that many succeeding editions may be required, because the author provides a wide range of skilfully classified information and an attractive stimulus to further study.

M. O. F.

Geology for Everyman. By Sir Albert Seward. (Cambridge University Press), 1943. Pp. xi *plus* 312. Nine plates and ten text-figures. Price 10*sh.* 6*d.* net.

There is a certain poignancy attached to this publication because it is the last book to be written by that eminent and versatile naturalist, Sir Albert Seward. He had completed writing the manuscript just three days prior to his sudden death. The aim of this book as stated by Sir Albert himself in the introductory chapter, is "to present a case for the inclusion of an intelligent interest in geology as part of that intellectual equipment we call general culture". He does not intend that the book should serve as an elementary text-book, but as an introduction to a branch of natural knowledge which could serve as a fascinating hobby, and according to Sir Albert, "a hobby, to be satisfying, must demand a certain amount of mental effort and should be such as can be progressively pursued until a stage is reached when a desire to know more opens up a prospect of work of one's own in a small patch of an unlimited field, modest in scope yet enthralling enough to produce the pleasant feeling of self-forgetfulness in research"

The opening chapters of the book are devoted to certain aspects of speculative geology, such as the constitution of the interior of the earth, and the origin of continents and oceans. The processes of dynamical geology, resulting in unceasing destruction and construction, are next briefly dealt with. Then follows a concise description of the more important sedimentary, metamorphic, and igneous rocks. The distribution over Britain of the various geological formations is next indicated, and a small-scale geological map of Britain helps the reader in following the descriptions which are presented in the novel manner of a series of traverses across the British Isles.

The bulk of the book deals with historical geology and as an introduction to this, there is a short chapter entitled "Medals of Creation" in which is given interesting information on what a fossil is, how it is preserved, of what value it is to the stratigrapher, and on the light it throws on problems of evolution, geographical distribution of plants and animals throughout the world, and climates of former periods.

Contrary to the usual method adopted in books dealing with historical geology, Seward follows a reversed chronological order, beginning with the latest deposited rocks instead of with the earliest. The description, therefore, starts with the Ice Age and with the conditions which prevailed when primitive man first inhabited the earth. Moving back in the scale of time, the long panorama of the earth's history covering hundreds of millions of years, is unfolded in simple but forceful language. Those who have read through this book which delineates "the pages of a chronicle far transcending human history" may well say with justification, "We have voyaged over strange seas, gathered scraps from the littter of woodland and forest that gave colour to changing landscapes; we have explored 'the stormy bases of the world' and 'the dust of continents to be'. To our vision has been given a greater power of penetration; we have read a little of the Epic of Creation and, little though it is, we have been brought nearer to a perception of the infinite".

The book is well printed and illustrated by eight plates on art paper and ten text-figures, with a very good portrait of the distinguished author as frontispiece. Written in charming language with numerous apt quotations, this book will long remain as one of the best popular introductions to the science of geology.

C. S. PICHAMUTHU.

Records of Department of Mineralogy. Professional Paper No. 1. By D. N. Wadia. (Government of Ceylon), 1943. Pp. 38.

The Ceylon Department of Mineralogy was organised afresh in 1939, replacing the old Mineral Survey Department which, since 1903, had been functioning with intermittent breaks. For the re-constituted Department, the Ceylon Government were fortunate to secure the services of Mr. D. N. Wadia—the well-known eminent Indian geologist—who had just then retired from the Geological Survey of India. As soon as he took charge of the Department, as Government Mineralogist, he started a systematic geological survey of Ceylon, which is being continued still. Naturally it would take some time to complete this detailed survey and bring out a comprehensive memoir on the Geology of Ceylon. In the meanwhile, he has planned to publish the results of the present investigations by periodic issues of professional papers of which the one under review forms the first in the series.

In this handy publication which consists of four sections, Mr. Wadia deals, in the first three sections, with the rare earth minerals of Ceylon, the origin of the graphite deposits, and the three superposed peniplanations, respectively; and in the fourth, he gives a bibliography of the Geology of Ceylon.

The first section opens with a concise account of the Archæn Complex of Ceylon which, forming the source of the rare earth minerals, covers nearly 9/10 of the surface area of the Island. This complex, as in the adjacent mainland of the Indian Peninsula, consists of gneisses and granites underlying a thick series of intensely altered sediments,—now in the form of crystalline schists and granulites comparable to those of the Dharwar System of the Deccan. The latter group is provisionally called, in Ceylon, the Khondalite System, Taprobane System, and Serindeb System, and consists of several rock types which have undergone intense plutonic metamorphism.

The gneisses, though showing some minor variations, are mostly biotitic with occasional hornblende; and they are intimately associated with granites of two or three different intrusive periods, often forming composite gneisses and migmatites.

The rare earth minerals, now found associated with the Khondalites and the alluvial deposits derived from them, are believed to have had their source in the igneous plutonic intrusives, crystallising to a small extent directly from the molten magma as fine disseminated particles, but mostly as coarser segregations in the pegmatites, veins, pipes, etc., as products of pneumatolytic action. There are altogether some 38 types of these minerals which have been briefly described in the paper.

In Section II is given a concise account of the physical and chemical characters, the mode of occurrence and association, and the paragenetic relations of graphite. This section includes 8 plates which illustrate clearly the occurrence of graphite as in infillings, branching veins, rosettes, etc. Discussing the origin of the vein deposits of graphite, Mr. Wadia states that they have resulted from infillings of pre-existing fissures, as intrusive veins and dykes, the graphite having been injected or squirted into fissures in the zone of sheared rocks. The author attributes a magmatic source to the graphite deriving its origin from the absorption of carbonaceous strata by intrusive masses of Charnockites and other related igneous rocks. During this process, it is explained, the calcareous base of the invaded limestone would be converted to lime silicates, and the liberated carbonic acid,—under high temperature and pressure—would be dissociated into gas or liquid carbon or reduced to graphite in the presence of hydrogen. The reviewer is glad to say that this explanation of the origin of the vein graphite in Ceylon conforms, more or less, to what he had expressed some years back in discussing the origin of a small vein deposit of graphite in Mysore.

In Section III, Mr. Wadia describes the three superposed peneplains of Ceylon;—the first forming the coastal plains ranging from 0-400 feet above sea level, the second reaching its maximum altitude up to 2,500 feet, and the third attaining its maximum altitude of 8,300 feet. The author regards the formation of these three superposed peneplains as the result of normal block faulting and successive block uplifts of the peneplained Archæn terrane, in two stages, and not due to the ordinary denudation of dip slopes as had been previously suggested by Adams; and in support of his view he adduces several field evidences.

The last section gives an extensive bibliography containing references not only to all the important papers which have been published on the Geology of Ceylon but also to a few papers which describe the allied rock formations in the adjacent mainland of Peninsular India.

The paper, on the whole, gives an interesting account of some aspects of the Geology of Ceylon and its important minerals, and further contributions from this author on the results of his investigations relating to the origin of the Charnockites and other rock types of Ceylon would be eagerly awaited.

B. Rama Rao.

Matter and Energy. By V. Venkatarao, Maharaja's College, Vizianagram. Pp. 98. Price Annas 8. Copies available with the author. Language Telugu.

This is the fourth of a series published by the author. The booklet is written in Telugu and deals with the results of modern research in respect of constitution of matter and energy. It is a direct result of the ambition on the part of the author to bring the currents of modern scientific thought within the easy reach of the individuals who are proficient in the different modern Indian languages but not so well conversant with English.

The booklet forms an interesting and lucid reading to a scientific person but it is somewhat doubtful whether it will make a lasting impression on the mind of a lay reader. Results of research of master scientists like Rutherford, Bohr, Compton, Raman and others are described in simple Telugu. The choice of expressions, though very good in many places, is not quite apt throughout. S. B.

An Introduction to Pollen Analysis. By G. Erdtman. (Chronica Botanica Co., Waltham, Mass., U.S.A.; Calcutta: Messrs. Macmillan Co.), 1943. Pp. 289. Price $5.

The science of pollen analysis is of comparatively recent origin. Within few years this young science has developed very rapidly and has perfected its technique and analytical methods to a surprising degree. Modern pollen analysis can be said to have begun in 1916, with the publication of L. Von Post's paper on "Fossil Pollens of Swedish Bogs". Some aspects of this science may be traced to a much earlier beginning but the more critical and modern aspect should be reckoned to have begun with Von Post's paper referred to here.

The utility of this science in throwing light on the past history of the vegetation of certain parts of the globe was doubted at one time by scientists of the orthodox school and those sceptical of the new line of approach. However, this science has grown out of this suspect stage and has established its claim to interpret correctly and to draw valid conclusions just as much as any other science seeking to do it. Thus pollen analysis has come to be an additional tool in the hands of botanists to throw light on the past history of vegetation, besides its being of considerable help in studying the trend of changes in floras of the present age.

A perusal of Dr. Erdtman's book on pollen analysis reveals how carefully this new science has been organised and the detailed extent to which the work has been systematised. This is not to say that the science has entirely perfected its analytical methods. That it is not so, is evident, from the warning the author has given in his preface. He emphasises the importance of paying greater attention to pollen morphology instead of as at present relying on empirical techniques. The book has been clearly written and even a beginner will find it easy to follow and pick up the methods. After tracing the history of the development of the science in the introductory chapter, one whole chapter is devoted to the chemistry of peat. This is necessary since it is with the formation of peat and its deposits that much of the work of pollen analysis has been concerned. Preparation of pollen and fossil pollen-bearing material occupy a chapter each. Morphology on which the author places so much emphasis occupies the greater part of the book. The publication is profusely illustrated with detailed diagrams of pollens and spores of many species of angiosperms, gymnosperms and pteridophytes. The elaborate manner in which the spores have been drawn and the details to which the characteristics of the exine and the intine have been illustrated, deserves appreciation. Analyses and graphic presentation of the result, which forms the most important part of the book and on the understanding of which would depend the correct interpretation of the results are fully explained. Some examples have been given of correlating the age and sequence of certain plant deposits, widely separated from each other, with the aid of pollen stratigraphy. Similarly the importance of pollen anlysis in the correlation of facts in palæoclimatology, geology and archæology are indicated. Pollen output and its dissemination, so very important to the science of pollen analysis, is adequately explained. A chapter on pollen flora of peat samples deals with different aspects that need consideration before any conclusion could be drawn from their studies. There is a brief chapter on the importance of pollen analysis in investigations on pollen grains of tertiary deposits.

Although a major portion of the book is in a sense palæobotanical in character, a chapter on pollen analysis of honey and drugs, however, unrelated to the major context of the book, has been added to indicate the importance of this new branch of botanical science. The countries in which pollen surveys have been undertaken have been listed and it is interesting to find that India is mentioned. Authors index and index of plant names form useful additions to the book.

It is natural that a great many investigators in the science of pollen analysis belong to countries of the North Temperate Zone which are rich in extensive peat deposits and fossil pollen-bearing stratas. It cannot be doubted that this science will play a very important role in tracing the past history of the vegetation of temperate countries. But it is, however, hazardous to pass any opinion as to the possible application of this science in countries of the tropics and the sub-tropics. It is possible that from pollen analysis will emerge the pollen systematics, analogous to plant systematics. Such a systematics when established would be of use in the identification of plants without recourse to other grosser parts.

Like all American publications, the printing, get-up and the paper used in this book leave nothing to be desired. L. S. S. K.

CENTRAL SUGARCANE COMMITTEE

THE Government of India have decided to set up a Central Sugarcane Committee which should undertake the improvement and development of the growing, marketing and manufacture of sugarcane and its products in India. This includes items such as agricultural, technological and economic research in sugarcane, gur, sugar and their bye-products, the improvement of crop forecasting and statistics, the production, distribution and testing of improved varieties, the adoption of improved cultural practices, inquiries and recommendations relating to banking and transport facilities and transport routes and the maintenance of an Institute of Technology. The Committee will inform the Central and Provincial Governments concerned on any points which may be referred to it by them, provided the subject-matter of the reference falls within the prescribed functions of the Committee. The members of the Committee will be 45 and include representatives of growers, manufacturers and traders.

The Government of India will finance the Committee by placing at its disposal the entire proceeds of the Sugar Excise.

SCIENCE NOTES AND NEWS

The Bituminous Coal Institute has announced that a new sulfa drug "Phthalyl sulphathiazole" renamed sulfa-halidine, has been discovered which is said to be the most effective intestinal antiseptic yet found. It will probably be highly effective in treatment of infections like bacillary dysentery, a scourge of hot countries like India. Extensive laboratory tests at Texas University Medical School proved that even after a prolonged series of treatments laboratory animals evidenced no toxic effects.

At a Conference recently called by the Imperial Council of Agricultural Research to consider ways and means of improving the quality of fruit products manufactured in India, it was unanimously agreed that legislation should be undertaken to ensure that fruit products manufactured in India conform to certain standard of hygiene and quality. Until such legislation was enacted, it was suggested that manufacturers should adopt the "Agmark" system under which certain conditions and standards of manufacture are laid down. The Conference agreed that a levy of Re. 1-4-0 for 100 labels of 'Agmark' should be collected and the income utilised for the maintenance of a suitable inspection staff and for carrying on the necessary propaganda so that the public may be sure of obtaining articles of quality manufactured under hygienic conditions.

A Technical Mission from the United Kingdom, headed by Mr. G. S. Gowing of the Imperial Chemical Industries Ltd., together with one other member of the Imperial Chemical Industries Ltd., and one of the Power-Gas Corporation Ltd., the latter representing the Association of British Chemical Plant Manufacturers, will visit India to advise on the production of artificial fertilisers for increasing food supplies. The Mission, acting for the Government of India, will undertake the following:—

(1) Investigate and report to the Government of India on the technical problems involved in the manufacture of sulphate of ammonia in British India in quantities up to 350,000 tons per annum.

(2) Recommend, in the light of the raw materials and power available in India, the most economic method of manufacture.

(3) Indicate the approximate capital cost of the plant or plants to be installed, and calculate the approximate cost of operations and production of finished sulphate of ammonia.

(4) Recommend the most suitable site or sites for the erection of the plants concerned, taking into account the raw materials available and the most economic distribution of the finished products.

(5) Estimate the amount and approximate value of plant which it will be necessary to import from outside India making the fullest possible use of materials and labour available in India.

(6) If, for any reason, it should appear that nitrogenous fertilizer, in a form other than sulphate of ammonia, can be more satisfactorily manufactured under Indian conditions generally or locally, consider and recommend from a technical point of view, the most economic method of manufacture of such alternative fertilizer.

(7) Estimate the capital and operating cost of manufacture of such alternative nitrogenous fertilizer.

Sir Azizul Haque, Industries and Civil Supplies Member, is calling a conference of leading industrialists who are expected to visit the U.S. sometime in autumn. The Conference is taking place in Delhi on the 29th instant. The following are among the invitees: Mr. G. D. Birla, Mr. N R. Sarkar, Mr. J. R. D. Tata, Mr. K. Lalbhai, Lala Padampat Singhania, Mr. M. A. Ispahani, Sir Sultan Chinoy and industrialists from Hyderabad.

It is learnt that a British delegation of machine tool experts is expected to visit India in the next cold weather. The delegation will advise the Government on the possibilities of increasing the output of machine tools by establishing or augmenting the machine tool industry in this country. The delegation is expected to stay for about four months.

An American Trade Mission has arrived in London to discuss the supply and distribution of goat skins with representatives of the British Ministry of Supply. The world-wide shortage of leather has brought the problem of co-ordinating supplies to the forefront. At present most of Britain's imported goat skins come from India. In America goats are bred for their hides but not yet on a scale to satisfy the requirements of the country. Developments of breeding and tanning processes will form part of the Missions programme.

To associate public opinion as clearly as possible with Central Government's policy for food administration, the Government have reconstituted the Central Food Advisory Council to advise the Department of Food on matters connected with the production, procurement and disribution of foodstuffs, including the rationing and the nutritional aspects of food supply.

To supplement the food requirements of urban areas, the Government of India have decided to launch schemes for increasing the production and supply of fish as part of their "Grow More Food" campaign. Dr. Baini Prasad, Director of the Zoological Survey of India, has been appointed Fisheries Development Adviser to assist Provincial Governments in preparing suitable schemes of development and co-ordinating the plans on an all-India basis.

The Madras Government have sanctioned the establishment of a Hydraulic and Irrigation

Research Station with experimental models to investigate river training methods, dissipation of energy below drops of canals and allied problems. The research station will be located at Poondi and will, it is expected, begin to function before the end of the current official year.

The decision of the Central Glass and Silicate Research Institute Committee to recommend that the Central Glass and Silicate Research Institute should be located at Calcutta, was announced by Sir S. S. Bhatnagar, Chairman of the Committee, at a luncheon given in his honour. Sir Shanti Swarup expressed his gratification at the keen interest shown in the matter by industrialists and scientists of Calcutta and at the handsome donations promised for the Institute.

Kashmir and Soviet Russia, which have a common frontier recently exchanged certain varieties of paddy. Experiments conducted at the Kashmir Rice Breeding Farm in pursuance of the rice research scheme worked in collaboration with the Imperial Agricultural Research Council, New Delhi, indicate that the Russian variety matures 4-6 weeks earlier than the indigenous variety thereby enabling Kashmir to have two paddy crops annually.

The Senate of the Calcutta University, at its meeting held recently, accepted an annual grant of Rs. 6,000 to the University from the Sir Dorabji Tata Trust for five years towards the recurring expenditure for the maintenance of the Cyclotron laboratory.

The High Commissioner for Australia in India, Lt.-Gen. Sir Iver Mackey, had addressed six of the Universities in India inviting their views on the subject of an exchange of University teachers and students between India and Australia. "It is the opinion of a number of influential Indians and Australians", he writes, "that interchange of students and teachers, besides conferring benefits upon the individuals concerned, provides one of the best means of promoting knowledge, understanding and goodwill between the participating countries. It is with this belief that I submit the matter for your consideration."

The Government of Mysore have donated a capital grant of Rs. 1 lakh for opening a Metallurgical Department at the Indian Institute of Science. A recurring grant of Rs. 15,000 for a period of five years has also been made.

It is announced that the Rockefeller Foundation have made a grant of up to Rs. 15,000 to the National Institute of Sciences of India, as a contribution towards the support of scientific journals in India.

Mr. K. R. Narayanan, a graduate of the Travancore University, has been awarded the Tata Scholarship of Rs. 16,000 for higher studies in England. He will join the London School of Economics to study politics, economics and journalism.

Dr. B. B. Day has been invited to address the Convocation of the Madras University scheduled to be held on the 24th of August 1944.

The Madras University, it is understood, has appointed Dr. Dinshaw R. Nanji, D.Sc. (Bir.), as Professor in the proposed College of Technology. He is at present Consulting Technologist in Birmingham and will be joining the University as soon as passage facilities are made available. Dr. M. A. Govinda Rau, M.A., Ph.D. (Lond.), is the Reader.

The Bombay University has awarded the Rustomji Ranchetji Desai's gold medal for 1943 to Dr. P. L. Narasimha Rao of the Indian Institute of Science, for his thesis on "Synthetical investigation in pinene group".

The ashes of Sir P. C. Ray have been preserved in an urn in his room in the University College of Science, Calcutta. The urn is placed on his favourite cot which he had used for years. It is proposed to preserve the room as a museum exhibiting his books, clothes and a few of his articles of furniture.

The Trustees of the Lady Tata Memorial Trust announce the Awards of the following Scholarships and Grants for the year 1944-45:

I. *International Awards for research in diseases of the blood with special reference to Leucœmias*—

(1) *Prof. L. Doljanski*, of Jerusalem: To continue studies on (*i*) Leucotic cells and agent of fowl leucosis *in vitro*; (*ii*) The X-ray susceptibility of leucotic agent; (*iii*) The cell affinities of oncogenic viruses and the mutual relationship between *Rous sarcoma* agent and agent of fowl leucosis. (*Grant of* £ 400 *third year's Award.*) (2) *Dr. Jacob Furth*, of American nationality, Cornell University Medical College, New York: To continue the work in progress upon the Leucæmias like diseases of fowls and their relation to neoplasms and to determine the nature of viruses producing leucæmias and associated neoplasms lymphomatosis, myelomatosis, endothelioma, sarcomas, etc. (*Grant of* £400, *tenth year's Award.*) (3) *Dr. P. A. Gorer*, Guys Hospital, London: To continue the studies in the genetics of mouse Leucæmia. (*Grant of* £70, *fifth year's Award.*) (4) *Dr. A. H. T. Robb-Smith*, Nuffield Reader in Pathology and Morbid Anatomy, Oxford University: To continue the aid to the establishment of a "Lymphonode Registry" in the School of Pathology at Oxford to aim at better classification and follow-up of human cases showing progressive hyperplasias and neoplasms of the lymphoreticular tissues including cases of leucæmias, lymphadenoma, lymphosarcoma, etc. (*Grant of* £350, *fifth year's Award.*) (5) *Dr. Werner Jacobson*, Part-time Sir Hailey Stewart Fellowship at the Strangeways Research Laboratory, Cambridge: To continue the study of making a histo-chemical study of the argentaffine cells of the gut epithelium, with a view to determining whether they are the source of the intrinsic factor of Castle, and hence their bearing on the problem of pernicious anæmia and other blood diseases. (*Grant of* £300, *seventh year's Award.*) (6) Provisional Grant of £400, to *the worker under Prof. Witts to confirm Dr. Jacobson's research*,

II. *Indian Scholarships of Rs. 150 per month each for one year from 1st July 1944 for scientific investigations having a bearing on the alleviation of human suffering*—

(1) *Mrs. Alamela Venkataraman, B.A., M.Sc.*, Haffkine Institute, Bombay: "Synthesis of Sulphanilamide Derivatives." (*Second year's Award.*) (2) *Mr. Arobinda Roy, M.Sc.*, University College of Science, Calcutta: "The Absorption Rate of Different Edible Oils Used in India and the Effect of Vitamins A and D and Hydrogenation." (*Second year's Award.*) (3) *Miss Violet DeSouza, M.Sc.*, Indian Institute of Science, Bangalore: "The Investigation of Strains of Yeast and Other Hybrids as Sources of the Vitamin B Complex." (*Second year's Award.*) (4) *Mr. Narayan Gopal Joshi, B.Sc*, Tata Memorial Hospital, Bombay: "Vitamin Metabolism in Cancer with Special Reference to Ascorbic Acid and Glutathione". (*First year's Award.*) (5) *Mr. P. K. Bhattacharyya, M.Sc.*, University College of Science, Calcutta: "Investigations on Anti-Bacterial Substances Produced by Moulds." (*First year's Award.*) (6) *Mr. S. Dattatreya Rao, B.Sc. (Hons.)*, Indian Institute of Science, Bangalore: "Investigations on the Influence of Tocopherol and Fat on the Absorption and Utilisation of Carotene and the Function of Carotene in the Animal System." (*First year's Award.*)

MAGNETIC NOTES

Magnetic conditions during April 1944 were less disturbed than in the previous month. There were 12 *quiet* days, 17 days of *slight* disturbance and 1 day of *great* disturbance as against 12 quiet days, 17 days of slight disturbance and 1 day of moderate disturbance during the same month last year.

The quietest day during April 1944 was the 14th and the day of the largest disturbance the 2nd.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Great
7, 11, 13, 14, 17–23, 25	1, 3–6, 8–10, 12 15, 16, 24, 26–30	2

One magnetic disturbance of moderate intensity occurred during the month of April 1944 while no magnetic storm was recorded in April last year.

The mean character figure for April 1944 was 0·63, being the same as that for April 1943.

Magnetic conditions during May 1944 were far less disturbed than in the previous month. There were 20 *quiet* days and 11 days of *slight* disturbance as against 13 quiet days and 18 days of slight disturbance during the same month last year.

The quietest day during the month was the 15th and the day of the largest disturbance the 1st.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days
	Slight
3, 5, 8–17, 19–23, 25, 26, 30, 31	1, 2, 4, 6, 7, 18, 24, 25, 27, 28, 29

No magnetic storm occurred during the months of May 1943 and 1944.

The mean character figure for the month of May 1944 was 0·35 as against 0·58 for May 1943.

M. PANDURANGA RAO.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 92, Nos. 4662–64.

"Journal of Agricultural Research," Vol. 68, Nos. 1-4.

"Indian Journal of Agricultural Science," Vol. 13, Pt. 5.

"Biochemical Journal," Vol. 37, Nos. 5-6.

"Journal of the Indian Chemical Society," Vol. 20, Nos. 11-12; and Vol. 21, Nos. 1-2.

"Journal of Chemical Physics," Vol. 11, No. 12; and Vol. 12, Nos. 1-3.

"Chemical Products and Chemical News," Vol. 7, Nos. 3-6.

"Discovery," Vol. 4, No. 11; and Vol. 5, No. 1.

"Endeavour," Vol. 3, No. 9.

"Experiment Station Record," Vol. 90, Nos. 1-3.

"Indian Farming," Vol. 4, Nos. 10-12.

"Transactions of the Faraday Society," Vol. 40, Pts. 1-4.

"Indian Forester," Vol. 70, Nos. 4-6.

"Mathematics Student," Vol. 7, Nos. 3 and 4.

"Indian Medical Gazette," Vol. 79, Nos. 3, 4 and 5.

"The Review of Applied Mycology," Vol. 23, Pts. 1 and 2.

"American Meteorological Society Bulletin," Vol. 24, Nos. 9 and 10; and Vol. 25, No. 1.

"Journal of Nutrition," Vol. 26, No. 6; Vol. 27, Nos. 1 and 2.

"Nature," Vol. 152, Nos. 3866 and 3869; and Vol. 153, Nos. 3873-77 and 3879-87.

"American Museum of Natural History," Vol. 53, Nos. 1 and 2.

"Indian Journal of Physics," Vol. 17, No. 5.

"Journal of Research of the National Bureau of Standards," Vol. 31, Nos. 4 and 5.

"Science," Vol. 98, Nos. 2546, 2549-51, 2553-56, 2558-59; and Vol. 99, Nos. 60-68.

"Journal of Scientific and Industrial Research," Vol. 2, Nos. 2 and 3.

"Science and Culture," Vol. 9, Nos. 10-12.

"Monthly Science News," Nos. 29-33.

"Sky and Telescope," Vol. 3, Nos. 2-6.

"Indian Trade Journal," Vol. 152, Nos. 1965-72; Vol. 153, Nos. 1973, 1974, 1976-81.

685-44—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

CURRENT SCIENCE

Vol. XIII] JULY 1944 [No. 7

POST-WAR PLANS*

MAY I offer you a warm welcome and my sincere thanks for the trouble you have taken in coming to Simla. I am afraid you have been put to considerable inconvenience and discomfort, but the work on which you are about to enter is of national importance—the shaping of the future of our primary industry—and with this thought let us begin our work.

I am not going to weary you with a long speech. You have before you valuable notes prepared by a committee of I.C.A.R., Sir Herbert Howard, Dr. Baini Prashed and Dr. Burns, which present a picture of our present and future problems. Discussions in this Committee will help in placing the various problems in their proper perspective, but what we need is quick decisions and equally quick action.

May I at the outset invite your attention to the realities of the situation. The total area of India is 1,000 million acres and of this only 360 million acres are cultivated giving 0·9 of an acre per head of population. In addition every 100 acres of cultivated land had to provide fodder for 56 cattle. Further only one-fifth of the area cultivated, *i.e.*, 56 million acres are irrigated while the remaining 288 million acres depend entirely on a precarious rainfall. It is this 360 million acres which have to produce food for our entire population and provide employment.

87 per cent. of our population lives in the villages; of this one-fifth or 68 millions are landless labourers. They constitute 17 per cent. of the total population of the country.

The new times have choked the normal channels of agricultural improvement; men of light and leading who could bring enterprise and new knowledge go to towns and never return to their village homes.

A large proportion of our population is undernourished and heavily in debt and is, therefore, incapable of taking full advantage of the available resources. Sir John Megaw has pointed out that only 30 per cent. of our population is adequately nourished. According to Dr. Aykroyd a balanced diet should have, in addition to 18 oz. of cereals a day, at least 8 oz. of milk, 1½ oz. of fat, 3 oz. of pulses and 10 oz. of vegetables and fruits. It should provide 2,600 calories. If foods other than cereals are not available, 26 oz. of cereals would be needed per person per day to supply the necessary calories.

Our first and foremost need is to provide an adequate quantity of good nourishing food for all the people who inhabit this land. The requirements of the different varieties of food have to be worked out by nutrition experts. The present production is approximately known. On this basis the increased production needed can be worked out for each Province and State. It is for the Committee to propose appropriate measures to disincrease the production of foods needed and to suggest how to distribute the same so that even the poorest and the humblest worker gets what he needs and to work out a development programme on an all-India basis.

The possibilities of increasing production are: (*a*) by bringing new areas under the plough and (*b*) by carrying on more intensive agriculture.

The most important means for the development of new lands is irrigation and in some places drainage facilities for colonization, such as housing, finance, etc., are also needed. I may add that an area of no less than 250 million acres is classified as culturable waste and fallow. This area is mostly unproductive because the rainfall is scanty and there are other factors which make cultivation difficult or unprofitable. These lands await capital and

* Address delivered by the Hon'ble Sir Jogendra Singh, Member for Education, Health and Lands, Governor-General's Executive Council, to the Post-War Policy Committee on Agriculture, Forestry and Fisheries.

enterprise for their development. It is for the Committee to suggest what action should be taken for the purpose.

The intensification of agriculture depends on seven factors, good cultivation, seed, irrigation, manure, drainage, bunding and crop management. This includes crop rotations and the growing of two crops in succession on the same plot of land in one year where only one crop was grown before. I am sure you will agree that Provinces and States should, in the words of Dr. Burns, plan to cut out waste of all kinds, waste of fertilising material, of water and of soil, and plan to utilise these forces to the maximum capacity.

One of our great difficulties is lack of accurate knowledge. This can only be supplied by undertaking surveys. This Committee might formulate the principles and the lines on which surveys by Provinces should be carried out regarding increasing production:—

(1) from lands already under the plough;
(2) by utilisation of lands now producing nothing, by bringing them under crops or trees or even grass.
(3) by protecting catchment areas and preventing land erosion.
(4) by extending irrigation from all the available sources.
(5) by husbanding all our indigenous sources of manure such as town refuse, farmyard litter, leaf mould, green manure, oilcake, bone-meal, etc.

It is essential to examine the whole field and lay down definite lines of investigation for the Provinces and States.

One of our most urgent needs is the production and multiplication of good seed of different kinds of crops grown. We will need nucleus seed farms for production and testing of new seeds under special officers dealing with each crop and large seed farms under good management for seed multiplication. It is large private farms that have done so much for production of seed and improvement of yields in the Punjab.

Then the greatest need in most parts of India for increasing production is water. It has to be considered as to how proper irrigation facilities can be provided for four-fifths of the cultivated area which at present depends on uncertain monsoon rainfall. At the same time it has to be determined what the policy of Government should be in respect of the financial returns from such works.

Our land has been starved and its fertility stabilised at a very low level. Proper application of manure can substantially increase yields. Dr. Burns holds that if we husband our manurial resources we can produce about one crore tons of compost manures. It may take a few years to produce fertilisers, but we can produce compost at no remote future if we start systematic work on its production. We may appoint a Sub-Committee to prepare a working plan for the production of compost, utilisation of town reufse and crushing of all the oil-seeds to increase the production of oilcakes. It can be safely asserted that if we could provide good seed and adequate manure for all the land under cultivation and proper irrigation, we can increase the yield by 50 per cent.

We are told that milk production should be increased by 300 per cent. to meet the normal demands of our population. I am confident from the results that have been achieved that if we feed and breed our cattle and follow the laws of animal husbandry we can increase our milk supply considerably in the course of the next ten or fifteen years. "It has been observed", says Dr. Burns, "that in selected herds where systematic breeding control and extensive culling has been practised, the average yield has been increased 400 per cent. in about 25 years". The Military Dairies have shown the way; we can begin by organising civilian dairies on the same lines. We can start collective dairies in all the towns by bringing the cattle kept by the individual town dwellers under proper management. Indeed, though I see little prospect of collective agricultural farming in India which is only possible if there were more land available, I feel there is an assured prospect for collective dairies under State supervision. I feel that a Sub-Committee should examine the problem of organising collective or co-operative dairies in all the towns. I may add that the question of utilising *Gaushalas* for cattle improvement is already being examined by a Committee under the capable guidance of Sir Datar Singh.

Again, the economic aspect of production needs attention. A cultivator cannot be expected to increase productions, if the increased producion is to reduce the money value of his labour. In order to maximise production we may have to guarantee to the cultivator an assured market for his produce at a remunerative price. This is a difficult problem but it has to be faced, not only in the interest of agricultural production, but in the interest of the general economy of the country.

It is on the purchasing power of the bulk of our population that the future expansion of industry and indeed the raising of the living standard of both rural and urban population depends. It is on creating an effective and increased demand for goods that employment for nearly 68 million landless village labour can be found.

I am sure you will agree that an assured market and the maintenance of a suitable level of prices giving a fair monetary return is the most effective incentive for the producer to use all his energies to make every clod productive. It is probable that as soon as European agriculture begins to recover the period of shortage will merge into surpluses and there is a prospect of disastrous and long drawn out slump in prices such as we experienced in the thirties.

The equitable distribution of what is produced so as to ensure a sufficiency for all, particularly for agricultural and town labourers, is an equally important problem. Whatever the cost of minimum food requirements, they have to be made available to all if freedom from want is to be secured. The cost of transport is an important point in this connection. It has sometimes been suggested that transport should be treated as a Service Department

rather than as a revenue-earning proposition and that the poor and needy should be subsidised. The advice of the Committee as to how the problem of equitable distribution is to be tackled would be much appreciated.

The problem of agricultural finance and liquidation of agricultural debt is closely linked with prices. We cannot place an agriculturist in a position to make the most of his land unless we arrange to liquidate agricultural debt and arrange both short-term and long-term finance. An agriculturist cannot repay his debt because the interest he agrees to pay is beyond his capacity and his borrowing reduces him to a position of serfdom to his creditor. There is no reason why for short-term loans an agriculturist should not bring his grain to elevators or warehouses established at convenient market places, by the State and raise money at usual bank rates. If this is done and decent warehouses are established, the Reserve Bank may be prepared to make advances at usual rates of interest. The building of elevators would incidentally lead to standardisation of the produce and placing it in the best possible market.

The Co-operative movement has done a good deal of spadework and I am holding a Registrars' Conference in Bombay in August under the auspices of the Reserve Bank of India to explore further possibilities of development. In this connection the role of money-lenders who could be led to organise themselves into modern village bankers, co-operative credit societies, commercial and State Banks has to be considered.

The problem of land tenure and subdivision of holdings is inextricably mixed up with land revenue and ownership in land. These are primarily the concern of the provinces. We can, however, consider the ways and means to intensify the campaign for the consolidation of holdings. In the Punjab, on the voluntary basis, it made great headway under the inspiring leadership of my old friend, Mr. Calvert. There is a great scope for consolidation of holdings in all the provinces. It may eventually lead to what some people desire, a law to prevent fragmentation, but the Committee will have to consider whether the time for legislation has arrived or will not arrive until half of our population ceases to depend for its subsistence on land.

The master plan must take into account the demand for raw material for the growing industries of the country and production with or without processing for the export market. These will provide opportunities for developing areas which need capital, knowledge and organisation to become productive; commercial crops such as sugarcane, cotton and other fibres, tobacco, fruits and vegetables can bear higher cost of production than cereals and under scientific cultivation are capable of giving very high returns.

In my speech at the Forest Rangers' Convocation at Dehra Dun, I dwelt on the need of conserving and extending our forests and developing village forests and utilisation of our minor forest resources. Sir Herbert Howard has clearly set forth that we must have 20 to 25 per cent. of the total area as forests as a safeguard against erosion, and to supply our fuel and timber demands. This plan aims at placing another hundred thousand square miles under forest, that is, almost doubling the present area. He has shown that even where rainfall is 10 to 15 inches, trees can be grown. In Sind with irrigation, trees have been raised on almost desert lands. We have vast areas which yield nothing and which can be put under forests. Indeed to save our land afforestation is a vital necessity. This is an inter-State and inter-Provincial problem. The question of the appointment of a Land Utilisation Commission may be considered by the Committee.

Finally no progress is possible without training and recruitment of staff for carrying out plans, which may emerge as the result of our deliberations. It stands to reason that if an All-India Agricultural Policy including irrigation, forestry and land management is to be initiated and Provinces and States are to be assisted we must have an adequate Central Staff of highly qualified men who can guide and assist the Provinces in translating potential possibilities of agricultural development into actualities.

Remember it is for the first time we are taking up the problem of feeding, clothing and housing our population, in a decent manner. We have to explore the deep and mighty resources of production with sympathies which must transcend the narrowness of Provincial and inter-State boundaries. It needs the wholehearted co-operation of the Provinces and States. I think we can rely on their co-operation for no Province or State is going to refuse what is for its good. The Governing Body of the Imperial Council of Agricultural Research provides a model which may serve for creating a Central Joint Authority to carry out the policy and purpose which receives the approval of all the Provinces and States.

Our problem is to set the wheel of wealth in motion to make agricultural production remunerative, to improve the urban wage, to create demand for goods and with it new avenues of employment, thus opening out an essential and enormous field of endeavour.

I am sure in our search for material wealth we will not forfeit our spiritual heritage which, in spite of chronic poverty, has given us a measure of contentment and dignity to grace the graceless present.

I may observe in passing that our Policy Committee will formulate the lines of post-war development and these will be considered by the Government as a whole. The planning contemplated by the Committee is naturally a long-term one; such developments as are calculated to yield a material increase and are taken up immediately will merge into the long-term programme.

Now, gentlemen, let us proceed with our discussion in a businesslike manner, and determine what action should be taken to increase production and secure its equitable distribution so as to improve the standard of living of the people as well as their health and efficiency in the interest of moral and material progress of our people.

WAR AGAINST LOCUSTS IN INDIA

By HEM SINGH PRUTHI, M.Sc., Ph.D. & Sc.D. (Cantab.), F.R.A.S.B., F.N.I.
(Imperial Entomologist and Director, Imperial Agricultural Research Institute, New Delhi)

IN a previous issue of *Current Science* (Vol. X, No. 11, 1941), the writer briefly described how the current cycle of the Desert Locust started in India during 1940 and gave a brief account of progress of the outbreak up to September 1941. The present note deals with the locust movements and breeding after this period, the control organizations of the Government of India and of various Provinces and States, and India's locust activities in other countries.

Locust Situation

1941-42: Monsoon breeding in Sind-Rajputana continued up to the end of November 1941, the locust completing two generations. The local swarms which started developing about the middle of September invaded, in addition to whole of Rajputana and Sind, western parts of the Central Provinces, southern and western districts of Rajputana, Punjab and North-West Frontier Province. During October they also went as far as Belgaum in Bombay Presidency (Lat. 15° 44′, Long. 74° 43′) and Bellary in Madras (Lat. 15° 10′, Long. 76° 52′). In the beginning of October, they started flying in the westerly direction. The majority of the swarms that overwintered in India perished due to excessive cold in the Punjab and United Provinces hills and a few survivors left India *via* Upper Baluchistan during January-February 1942. After this, no swarm activity was reported from any part of India and accordingly there was no gregarious breeding during spring or early summer.

1942-43: Though there was no spring or early summer breeding in Baluchistan, but in Iran, Oman (Arabia) and other 'winter-rainfall' countries heavy breeding took place. The resultant swarms from these extra-Indian tracts commenced reaching India early in June, the earliest swarm being noted at Panjgur (Mekran-Baluchistan) on 5th. They passed over Sind and western Rajputana without egg-laying as at that time rainfall had not yet started, reached as far south as Vasna near Baroda (Lat. 23° 15′, Long. 80° 34′) on 8th July.

Soon after the middle of June, rainfall started and eggs were laid over extensive areas in eastern Rajputana, northern parts of Central India, States of Gwalior, Alwar, etc., and south-western districts of the United Provinces.

Breeding was very light in western Rajputana and in Tharpakar district of Sind. In other areas active breeding continued during July-August and energetic control operations were carried out in most parts of Rajputana except a few tracts where some hopper-bands escaped destruction and the swarm formation commenced during the first half of August. These invaded the western parts of Rajputana, Sind and Bahawalpur State. Moreover, about this time, further incursion of large number of individual locusts from west was observed and these got intermixed with the home-developed swarms. By this time western half of Rajputana, Sind and Bahawalpur had also received good rainfall and heavy breeding started in these tracts. During the second generation breeding in all areas good conrol work was carried out except in Jaisalmer and some adjoining areas, thus giving rise to a few swarms. This second brocd of home-developed swarms mostly flew towards north and north-east and some flew towards west. Of the latter, about half a dozen crossed the Indian frontiers into Iran and Arabia.

A small number of swarms overwintered in northern Punjab and western Sind. Towards the end of January (1943) some swarms appeared in western Mekran (Baluchistan) and laid eggs. Oviposition also commenced in the northern Punjab in the end of January and in Sind during February. Due to thorough surveys and prompt control work hoppers were not allowed to become adults in all the areas excepting in some parts of the Punjab where a number of hopper bands escaped destruction and the resultant swarms penetrated the North-West Frontier Province and led to late spring breeding. In Mekran the pest was almost completely destroyed by the end of March but unfortunately several fresh swarms came from Persian side early in April and spread over whole of Baluchistan and laid eggs. Second generation breeding followed in western Mekran, Jhalawan, Kharan and Chagai District but the situation was soon brought under control.

1943-44: Whereas some of the immigrant swarms referred to above, that came from Persia during April, remained in western Baluchistan and laid eggs, others flew eastward and reached Kachhi and Bahawalpur areas by the end of April. During May and June they penetrated into Sind-Rajputana, western India, U.P. and Bihar, the southernmost locality reached by them was Bilaspur (Lat. 22° 07′, Long. 82° 13′) in the Central Provinces and the easternmost was Patna (Lat. 25° 41′, Long. 85° 17′). Since breeding continued in Persia up to the middle of July and a large number of hoppers escaped destruction in that country India was invaded by a second wave in the end of May and subsequent incursion of swarms was continued up to August. To some extent they were supplemented by swarms which developed in northern Punjab and N.W.F.P. in the past spring referred to above.

Localised rainfall was received after the middle of June followed by locust breeding in some parts of Jodhpur, Bikaner, Jaisalmer and Jaipur. There was widespread heavy rainfall in Sind-Rajputana beginning from 10th July

and this was followed by heavy breeding in whole of Tharparkar district, northern and western parts of Jodhpur, almost whole of Jaisalmer and Bikaner, Shekhawati desert of Jaipur and southern parts of Bahawalpur State. Some semi-desert districts of Jaipur State and Hissar district of Punjab were also affected. Towards the end of August and early in September further oviposition took place in north-eastern Bikaner, Shekhawati desert of Jaipur, Ferozepur, Hissar and Ludhiana districts, Bahawalpur, Patiala, Nabha and Loharu States in the Punjab. Energetic control work was carried out and in almost all cases the hoppers were destroyed before they passed the middle age. In spite of the fact that the breeding was very heavy, only about half a dozen small swarms developed in whole of north-west India. Most of these flew towards south-west and reached the sea coast between Karachi and Cutch State. None penetrated into Mekran or crossed the Indian frontiers. No swarm was observed in any part of India after the 12th November and presumably they got scattered or perished into the sea. Anticipating that some locust swarms in India will escape destruction and migrate to Persia in the autumn, the Middle East Anti-Locust Unit had established an organization at the Indo-Persian border to destroy such swarms. But our work in India had been so thorough that the organization had to be disbanded without coming across any swarm flying from Indian side.

In view of the foregoing, it was hoped that the locust cycle had been brought to an end in the Eastern Zone (India, Persia, E. Arabia, Iraq, etc.), by the successful control measures adopted by the Indian anti-locust organisations. Though there was no breeding during early spring (1944) in Persia or Oman active breeding had been in progress in Sudan, East Africa and Coasts of Red Sea throughout the past winter and spring. Some foreign experts assured us that India will not be invaded this year. Unfortunately, however, India was once again unexpectedly invaded by swarms from Arabia during last March-April (1944). As soil moisture conditions were very suitable in Baluchistan, they laid eggs over extensive areas in Mekran, Jhalawan, Kharan, Chagai, Lasbela and Chaman areas of the Province. In Sind also breeding is in progress in western parts, *viz.*, Dadu and Larkana Districts. The local Administrations under the supervision of Central Government staff are effectively dealing with the situation in Baluchistan and many localities have been cleared of hoppers. It is hoped that swarms will not be allowed to develop from any part except perhaps a few inaccessible valleys in Baluchistan. On the other hand, it may be mentioned that breeding is also in progress in Arabia, Persia and Afghanistan and from the available information it appears that swarms will develop from these regions and invade India in the summer.* It is feared that during the coming monsoon we shall have once again to deal with a serious situation, therefore, we have accordingly made preparations for a large-scale campaign during the next monsoon weather.

* As anticipated swarms have invaded several States of Rajputana by the end of June.

ANTI-LOCUST ORGANIZATIONS IN INDIA

As described in the previous communication (*Current Science*, Vol. X, No. 11, 1941), the present locust cycle started in 1940, a very critical time because of the war, and thus the food supply both for the troops and civil population even otherwise difficult became very serious. To fight this pest the Government of India immediately took steps. States being independent and Provinces autonomous in agricultural matters, every Province and State is responsible for the destruction of crop pests including locusts in its jurisdiction. In the past, anti-locust measures were independently undertaken by the Provinces and States affected with the result that often good work carried out by one Administration was undone through the neglect of its neighbours. This was specially so because the territories which contain the largest permanent desert breeding grounds are naturally poor agriculturally and, therefore, have little inducement to incur heavy expenditure on locust destruction. Appreciating the all-India, in fact the international importance of locust, the Central Government is maintaining since 1939 a permanent Locust Warning Organization in the charge of their Imperial Entomologist at New Delhi, with field staff posted at strategic points all over north-west India, right up to the western borders of Baluchistan. This organization continually surveys the permanent breeding areas, even when the locust is in the solitary phase, to study the rise in the population of the pest, and issue periodic warnings and forecasts about locust invasions. When the present outbreak started, this organization was suitably expanded and in addition to carrying out locust intelligence work was made responsible for directing and co-ordinating the anti-locust work of various Provinces and States in which the locust might be breeding. By the autumn of 1941 some larger measures of co-ordination of work in various Provinces and States had become necessary. Locust conferences of all the Province and States in North-west India were held in October 1941 and April 1942 and a co-ordinated locust control scheme was approvid and put in operation in May 1942. According to this scheme the cost of locust destruction in the permanent desert breeding areas was to be shared by the respective Governments of the territories that were liable to locust attacks according to an agreed formula. The participating Governments also bear the cost of special technical staff, who are stationed in various Provinces and States containing the permanent breeding grounds and who advise local authorities regarding suitable control methods to be adopted and with whose assistance the Imperial Entomologist co-ordinates control work in India as a whole. This Co-ordinated Scheme proved very successful in 1942 campaign, was renewed in 1943 with the consent of the Provinces and States concerned and has recently been again extended for the 1944-45 season. The Government of India appointed a Deputy Locust Entomologist in 1943 to ensure proper supervision of control operations and the Locust Warning Organization has been

further strengthened recently by the appointment of another Deputy Locust Entomologist.

INDIAN LOCUST ACTIVITIES IN OTHER COUNTRIES

It has already been made clear that India, Persia and Arabia are inter-dependent in regard to locust activities, since swarms developed in one country invade others. In view of this, at the request of the Middle East Supply Centre, the Government of India sent delegations of Indian entomologists for control work in Persia during 1941-42 and 1942-43, and in Arabia during 1942-43 and 1943-44. Indian troops were also employed for locust work in Persia during 1942-43 and 1943-44 where they were mainly responsible for carrying out timely control work. At the request of the Middle East Anti-Locust Unit, the Government of India took over the responsibility for carrying out control work in Persian Mekhran in February 1944. The organization is also working under the direct control of the Imperial Entomologist at New Delhi.

In addition to sending control missions described above, the Imperial Entomologist was deputed to attend an International Locust Conference at Tehran in October 1942 and again at Cairo in July 1943 where important decisions were taken with regard to the organization and technique of locust control work on international basis. To carry out well-organized work in Persia an International Control Committee was established at Tehran early in 1943 and a Government of India's representative (Superintendent, Locust Substation, Karachi) resided at Tehran for about three months during 1943 and two months during 1944, taking active part in the deliberations of the International Committee.

UNIVERSITY COLLEGE OF TECHNOLOGY, MADRAS

FACILITIES for higher technological studies in the Madras area will henceforth be available at the new University College of Technology, which is for the present located as a temporary measure in the Government College of Engineering, Guindy. The inauguration of this College is well timed as there will be a great demand for chemical engineers and technologists in the post-war era of industrial reconstructions and developments in this country. Considerable progress has already been made under the auspices of the B.S.I.R. in various branches of Chemical Industries and a number of new processes have been developed in recent years. In order to preserve this progress, and to develop further processes in a keenly competitive world in the post-war years specialised chemical engineering talent and technological grounding and skill will be in great demand. It is, therefore, a happy augury that the Madras University has pushed forward with its arrangements for contributing to meet these very essential national demands. Parallel courses in Chemical Engineering, Leather Technology, Textile Chemistry, Electrochemistry, Fermentation Technology, etc., are under contemplation, but a beginning has been made this year with the Chemical Engineering course, through the kind courtesy of the Government of Madras, who have made available to the University the vast resources of the engineering laboratories and the workshop facilities at their College of Engineering, Guindy. The College is promised a substantial financial aid by way of a munificent grant from Dr. Rm. Alagappa Chettiar, of more than Rs. 3 lakhs non-recurring, and an annual recurring grant of Rs. 25,000. The Government of Madras are also giving generous grants towards the building, equipment and maintenance of the College which has been so boldly ventured upon by the University in these difficult times from out of its own funds.

A good start has already been made with the appointment of highly qualified staff. Dr. D. R. Nanjee, who comes out shortly to India after nearly twenty years of experience in England, both in the Universities and as a Consulting Chemist, will be the Professor and Director of the College, while Dr. M. A. Govinda Rau, who has successfully organised and conducted the courses in Chemical Engineering at The Indian Institute of Science, Bangalore, will be the Reader in charge of Chemical Engineering.

Great credit is due to the learned and enthusiastic Vice-Chancellor of the University, Dewan Bahadur Dr. A. L. Mudaliar, for it was he who proposed the scheme nearly three years ago and should now be justly most happy at these successful results of his tireless efforts. We congratulate Dr. A. L. Mudaliar and the University on the occasion of the Inauguration of the new College by His Excellency the Governor on the 28th of this month. The honorary degree of Doctor of Laws will be conferred upon Dr. Rm. Alagappa Chettiar at a special Convocation held on the same occasion.

LETTERS TO THE EDITOR

REYNOLDS'S NUMBER AND LIQUID HELIUM II

The peculiar properties of liquid helium II which have been discovered in recent years have so far received no satisfactory explanation.* The remarkable feature of the flow of liquid helium II is the fact that it is almost independent of pressure.

If V denotes the volume-rate of flow through a capillary tube under an applied pressure difference p, then the different types of flow are distinguished by the value of n in the relation: $V = Ap^n$,
where n is equal to 1 for Poiseuille's flow, ½ for turbulent flow and zero for He II flow. It is interesting to note that for the third type of flow, dimensional considerations require that the Reynolds number $u\rho D/\eta$ must remain constant, the value of this constant, of course, depending upon temperature. For this case, the velocity of flow will be inversely proportional to the diameter of the capillary tube and the volume-rate of flow will vary as the first power of the radius and not the fourth power which characterizes Poiseuille's flow.

It will be of interest to find out whether the flow of liquid helium II is really characterized by the constancy of Reynolds's number, and if such happens to be the case, it may well prove to be the simplest type of flow.

Baroda College, D. V. Gogate.
June 15, 1944.

* London, F., *J. Phys. Chem.*, 1939, p. 43.

OPTICAL CONSTANTS OF TUNGSTEN AND ANTIMONY DETERMINED BY REFLECTED POLARISED LIGHT

Experimental determination of optical constants of metals has received a quickening impulse as the result of the application of quantum mechanics to the metallic state. The present tendency has been firstly, to check the old data under improved experimental conditions; secondly, to investigate how far the polishing and contamination of surfaces are responsible for the variation in the values obtained by different workers; and thirdly, to supply the data for the metals which have not been thoroughly worked as yet. This note supplies the experimental data for Tungsten and Antimony and discusses the effect of polishing.

The experimental arrangement is that of Drude's[1] in which a beam of plane polarised light, when reflected from a metal surface, suffers a change in the state of polarisation. Locally constructed Half-shades, as suggested by L. Trontstad,[2] have been used for increasing the sensitiveness of the apparatus.

The literature on the subject[3] shows that the data for Tungsten and Antimony are few and very old. We have determined these for the range 4600 Å to 6600 Å at intervals of 200 Å and studied the variation dependent on polishing. Surfaces were prepared by taking massive metal which was rubbed flat against a file. Starting with the coarse emery paper, spread on a flat glass surface, it was ground in a particular direction so that all scratches developed in that direction only. With the next finer emery paper it was ground in a direction at right angles to the previous one. This process was continued till the finest emery paper was reached. These last fine scratches were removed by rubbing it on a pad of old cloth covered with a paste of finely powdered aluminium oxide and held against a flat glass surface. Alternate use of magnesium oxide was also made. This process of slow hand-polishing was continued till scratches were removed. Finally, the surface was washed with soap-solution and then with alcohol to remove any trace of grease. First set of observations were made on lightly polished metallic surfaces. Same surfaces were further polished and measurements were repeated. Representative values from two such sets of measurements have been denoted by (A) and (B) respectively in Tables I and II.

TABLE I
Data for Tungsten

Wave-length in Å	nk (A)	nk (B)	n^2k (A)	n^2k (B)
6600	3·59	3·80	11·4	10·4
5600	3·12	3·49	7·23	9 22
4600	3·51	3·34	9·59	8·06

TABLE II
Data for Antimony

Wave-length in Å	nk (A)	nk (B)	n^2k (A)	n^2k (B)
6600	4·94	4·61	4·10	11·2
5600	4·06	3 88	2 69	5·16
4600	3·30	2·14	1·86	2·97

Mott[4] has concluded, after a comparison of the results of Minor, Tool and Lowery, that the crystalline metal absorbs less strongly than the amorphous polished layer. Heavier polishing produces thicker amorphous layer and consequently absorption is greater as is indicated by the increased value of n^2k. It has been further pointed out[5] that in the case of copper, as given by Lowery, nk is less sensitive to the method of polishing than n^2k (Mott uses the notations nK and K for Drude's n^2k and nk respectively). In the case of antimony exactly similar results have been obtained by us. In the case of tungsten also this tendency is clearly manifested for the majority of wavelengths, with the only difference that the lightly polished surface gave a minimum value for n^2k at 5400 Å which disappeared with the heavier polish.

Physics Department,
Science College,
Patna,
April 25, 1944.

L. M. CHATTERJEE.
K. N. PRASAD.

1. Wood, *Physical Optics*, 3rd Ed., 1934, page 542. 2. Tronstad, L., *Jour. of Scientific Instruments*, 1934, **11**, 144. 3. International Critical Tables, 1929, Ed., **5**, 248: *Landolt-Börnstein Physikalisch-Chemische Tabellen* 1923 Ed., 903. *Ibid.*, Erster *Erganzungsband*; 1927 Ed., 463. Seitz, F., *The Modern Theory of Solids*, 1940 Ed., 656. 4. Mott, N. F. and Jones, H., *The Theory of the Properties of Metals and Alloys*, **1936** Ed., 117. 5. —, *Ibid.*, 121.

A PRELIMINARY NOTE ON THE APPLICATION OF ABSORPTION-SPECTROSCOPY TO TIMBER WOOD EXTRACTS

LAST December (1943) during the War Services Exhibition held at Nagpur, a conversazione was arranged by the local Science College. There we witnessed certain interesting demonstrations on Spectroscopy, Raman Effect, and Irradiation of Chemical Substances under cathode rays, etc. It then occurred to us why we should not employ spectroscopy for the elucidation of our problem, namely, that of the Identification of Timber Woods.

The problem was discussed with Dr. A. S. Ganesan of the Physics Department of the Science College (Nagpur) and he very kindly offered to take spectrographs of the absorption-spectra of iron in relation to water extract of timber woods.

We then approached Mr. Haji Fazal, a well-known furniture-maker and timber merchant of Nagpur, and he very kindly placed at our disposal for experiment the following four important timber woods commonly employed in the manufacture of funrniture:—

(1) *Bija* or *Bijasaal* (*Pterocarpus marsupium* Roxb. (Leguminosæ).
(2) *Sagwan* or Teak (*Tectona grandis* Linn.) (Verbenaceæ).
(3) *Siwan* (*Gmelina orborea* Roxb.) (Verbenaceæ).
(4) *Salai* (*Boswellia serrata* Roxb.) (Burseraceæ).

Thin fine shavings of each of the specimens aforesaid were taken off by planing. Equal quantities of these were separately boiled in equal volume of tap-water for fifteen minutes each, in glass beakers and they were subsequently allowed to cool down. Thereafter each one of them was separately filtered through fresh filter-paper and the filtrate collected in glass beakers. The tap-water, being the mother-liquor in each case, was, therefore, taken separately and was marked as Control. We had thus five samples of liquids for our experiment.

These five liquids (including the tap-water) were subjected to spectroscopic examination and spectrograph of their absorption-spectrum was taken in an arc light emitted from iron electrodes. The spectrograph as seen in the text-figure is the result and it shows the following:—

(*a*) Fe: The spectrum of iron.
(*b*) Control: The spectrum of iron through tap-water.

– Fe
—Control.
—1
—2
—3
—4

(c) 1: The spectrum of iron through filtered tap-water extract of wood shavings of *Bija* or *Bijasal* (*Pterocarpus marsupium* Roxb.)
(d) 2: The spectrum of iron through filtered tap-water extract of the wood shavings of *Sagwan* or teak (*Tectona grandis* Linn.)
(e) 3: The spectrum of iron through filtered tap-water extract of the wood shavings of *Siwan* (*Gmelina arborea* Roxb.)
(f) 4: The spectrum of iron through filtered tap-water extract of the wood shavings of *Salai* (*Boswellia serrata* Roxb.)

It will, thus, be seen that the absorption-spectrum in each case is very clear and characteristic gradually fading and disappearing in varying degrees towards the violet end of the spectrum. In *Pterocarpus marsupium* Roxb. (text-figure 1) the quantum of absorption is remarkably great, whereas *Gmelina* arborea Roxb. (text-figure 3) surprisingly enough shows a discontinuous phenomenon of absorption in its spectrum. The other two, namely, *Tectona grandis* Linn. (text-figure 2) and *Boswellia serrata* Roxb. (text-figure 4), display characteristic absorption of their spectra in varying degrees.

The experiment was repeated several times even (*a*) with tap-water extracts taken from different specimens of the same species of timber-wood, and (*b*) with concentrated tap-water extracts of the very same four species of timber-wood under study, but the result in each case was found to be invariably always in close conformity with the findings of our very first spectrograph.

The study has, by now, been extended to two other species of wood, namely, of *Neem* (*Azadirachta indica* A. Juss.) (Meliaceæ) and of *Santra citrus suntara Engl.* (Rustaseæ). Here also the absorption-spectra are specific for each of them.

Further study and investigation are in progress.

We wish to record our sincerest thinks to Dr. A. S. Ganesan, Physics Department of the Science College, Nagpur, for his valuable help, to Mr. H. S. George, Chief Conservator of Forests, C.P. and Berar, Nagpur, for very kind and ready permission to make a free use of his Departmental Library, and to Mr. Haji Fazal, Nagpur, for his generous offer of the specimens of timber-woods for our experiments.

(Miss) R. Shah.
T. C. N. Singh.

Horticulaural Research Institute,
Nagpur—Ajni, C.P.,
June 11, 1944.

CURRENT BEDDING AND TECTONICS

In a recent letter to *Current Science*[1] Professor Rode objects to my use of the disposition of current-bedded structures in determining the stratigraphical and tectonic sequence of the Central Himalaya,[2] on the grounds that the method is of doubtful value when applied to disturbed rocks. It is only in the study of disturbed rocks, however, that there is any need to use bedding textures and structures in fixing the stratigraphical order. In undisturbed regions the sediments are normally accepted as lying in their original order of deposition. The current-bedding method has been extensively employed in Northern Europe,[3] and, apart from the Himalayan region now under question, has been adopted by C. S. Pichamuthu in his study of the Archæan rocks of the Chitaldrug Schist Belt.[4] Not only are such structures preserved in areas of complex thrusts and overfolds, but they may be recognised in rocks which have undergone the effects of meso-grade metamorphism.[5] I have seen them in many places in the garnet-biotite-quartz granulites of the Main Himalayan Range.[6] For the preservation of such structures it is only necessary that strong shearing stress or excessive soaking should not have been operative in the rising and ebbing tide of metamorphism.

In the case of the Tal rocks of the Central Himalaya, we are not concerned with any possible obliterating effects of metamorphism on bedding structures. Apart from very local crush effects, the Tal rocks in the basins between longitudes 77° 30′ and 79° are not metamorphosed, although there has been selective silicification of some of the sandstones as compared with the shales, due to the greater permeability of the sandstones to solutions carrying silica. The Tal quartzites and sand-

↑

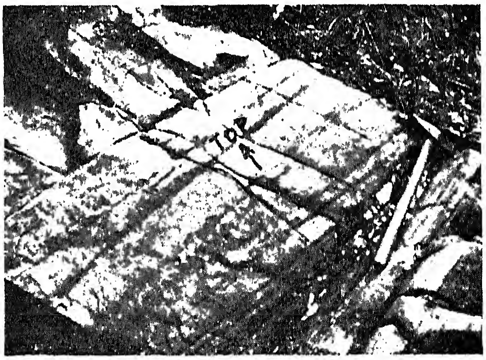


FIG. 1. Current-bedded Upper Tal quartzites. Map No. 53 J/3 (30°22′30″:78° 9′30″). Feb. 1936

↑

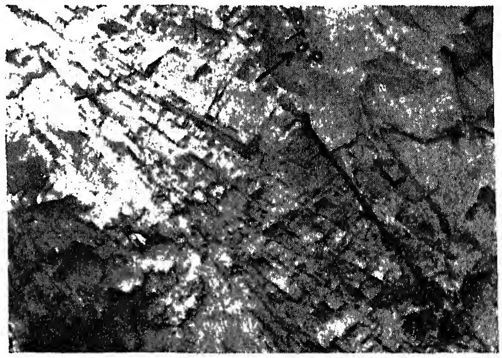


FIG. 2. Current-bedded Upper Tal sandstones. Map No. 53 J/3 (30°4′:78° 30′). May 1936.

stones possess, unequivocally preserved, excellent current-bedded and ripple-marked structures. The former have proved that the Upper Tal arenaceous rocks, and the Lower Tal shales into which they grade downwards, are not inverted. Two photographs of current-bedding in the Tal quartzites and sandstones are submitted with this letter, in both examples the concave sides of the current-bedding planes facing upwards towards the Tal limestone and, in the Ganges section, the overlying Nummulitic series.

Although it is not necessary in areas removed from orogenic zones to prove the correct order of deposition, current-bedding sometimes provides useful information about palæogeographical conditions. The Vindhyan system of Peninsular India offers an interesting study by this method.[7]

Geological Survey of India,
Calcutta, J. B. AUDEN.
May 11, 1944.

1. *Current Science*, 1944, **13,** 74. 2. *Rec. Geol. Surv. Ind.*, 1933, **67, 392.** 3 *Geol. Mag.*. 1930, **67,** 68–92. British Regional Geology: The Grampian Highlands, 1935, 29. 4. *Curr. Sci.*, 1937, **6,** 95. 5 Die Gesteinsmetamorphose (Grubenmann-Niggli), 1924, 62. 6. *Rec. Geol. Surv. Ind.*, 1935, **69,** 135. 7. *Mem. Geol. Surv. Ind.*, **62,** 1933, 216.

ASSAY OF FERRI SUBCHLORIDUM CITRATUM, B.P.

THE method recommended by the B.P.[1] for the assay of ferri subchloridum citratum consists in dissolving an accurately weighed quantity of the powder in dilute sulphuric acid and determining the ferrous iron in the solution by titration with standard potassium dichromate, using a solution of potassium ferricyanide as external indicator. C. G. Lyons and F. N. Appleyard[2] have shown that the official method gives results which are appreciably too high. They have recommended the use of ceric sulphate in place of potassium dichromate for the titration of the ferrous iron. Phenyl anthranilic acid or ferrous *o*-phenanthroline ion have been recommended as internal indicators. Other indicators were tested and found to be less suitable. C. G. Lyons and F. N. Appleyard[3] have also found that in the assay of saccharated iron carbonate by titration with dichromate, cane-sugar interferes by giving too high results. C. Morton and D. C. Harrod[4] also observed the interference of carbohydrates in the determination of ferrous iron by titration with potassium dichromate, using either potassium ferricyanide as the external indicator or diphenyl amine as the internal indicator. They recommended the employment of Heisig's[5] method in such circumstances. C. R. Viswanadham and G. Gopala Rao[6] have found that oxalic, tartaric, and citric acids interfere in the titration of the ferrous iron by dichromate, using both the internal and external indicators. They have explained the phenomenon on the basis that the reaction between ferrous salts and dichromate induces the reaction between dichromate and organic acids like oxalic, tartaric and citric acids.

We have now found that an accurate assay of ferri subchloridum citratum is possible by using sodium vanadate as the oxidizing agent in place of potassium dichromate for the titration of the ferrous iron. A decinormal solution of sodium vanadate is prepared and standardised as follows: The requisite quantity of pure ammonium vanadate, "Merck", is weighed out into a conical flask, distilled water added, together with a slight excess of pure sodium carbonate and boiled to drive off the ammonia completely. The resulting solution of sodium vanadate is transferred to a measuring flask and made up to the mark. We found that a solution of sodium vanadate made in this way keeps quite well. An aliquot volume of standard (decinormal) ferrous ammonium sulphate solution is taken in a beaker, 0·5 c.c. of a 0·1 per cent. diphenylamine indicator solution and 2 to 3 c.c. of phosphoric acid are then added followed by 10 c.c. of 4 N sulphuric acid. The ferrous solution is then titrated with the sodium vanadate solution, run from the burette until a permanent blue-violet colour results. The solution may suitably be diluted. A correction of 0·3 c.c. of N/10 vanadate solution to be subtracted from the titre is to be applied for 1 c.c. of 0·1 per cent. indicator solution.

In the following tables we record the results of the determination of ferrous iron in admixture with citric acid in about the same proportions as in ferri subchloridum citratum, under

TABLE I

Amount of ferrous iron taken = 0·0431 gm.

Amount of citric acid added	Amount of ferrous iron found by the official method (dichromate titration)	Amount of ferrous iron found by the authors' method (vanadate titration)
0·00875 gm.	0·0470 gm.	0·0431 gm.
0·01750 ,,	0·0504 ,,	0·0429 ,,
0·03500 ,,	0·0560 ,,	0·0431 ,,
0·10500 ,,	0·0683 ,,	0·0428 ,,
0·17500 ,,	0·0730 ,,	0·0433 ,,

TABLE II

Amount of citric acid added = 0·0350 gm.

Amount of ferrous iron taken	Amount of ferrous iron found by the official method	Amount of ferrous iron found by the authors' method
0·02155 gm.	0·0339 gm.	0·02150 gm.
0·04310 ,,	0·0593 ,,	0·04310 ,,
0·06465 ,,	0·0825 ,,	0·06480 ,,

the same conditions as prescribed in the B.P. as also in different proportions by titration with a decinormal solution of dichromate using the external indicator, and those obtained by titration with the sodium vanadate with diphenylamine as the internal indicator.

From the results given in Tables I & II, it will be seen that the amount of ferrous iron found by the official method is always in excess of the quantity actually present and this varies with the variation in concentration of both the ferrous iron and the citric acid. On the other hand, the determinations made by the authors' method gave accurate values. Titration with sodium vanadate is thus found to be quite accurate and convenient for the assay of ferrous iron in the drug ferri subchoridum citratum. Unlike the method proposed by C. G. Lyons and F. N. Appleyard, the authors' method employs the common laboratory reagent diphenylamine as the internal indicator.

Andhra University, G. GOPALA RAO.
May 20, 1944. C. R. VISWANADHAM.

1. *British Pharmacopœia*, 1932. *First Addendum*, 1936, 33–34. 2. Lyons, C. G., and Appleyard, F. N., *Quart. J. Pharm.*, 1937, **10**, 348. 3. —, —, *Ibid.*, 1936, **9**, 462. 4. Morton, C, and Harrod, D. C., *Ibid.*, 1936, **9**, 480. 5. Heisig, G. B., *J, Amer. Chem. Soc.*, 1928, **50**, 1687. 6. Viswanadham, C. R., and Gopal Rao, G., *Curr. Sci.*, 1943, **12**, 327.

CHEMICAL COMPOSITION OF BOMBAY SHARK LIVER OIL

NIYOGI *et al.* (1941),[1] (1943)[2] have found by tintomtric and biological methods that the liver oils of some of the fish available in Bombay coastal waters are considerably richer in vitamin A than cod liver oil. Since Indian shark liver oils are now on market as substitutes for cod liver oil, it was considered desirable to investigate the chemical composition of the oil obtained from Bombay shark of the following description:

Local name—Mushi; scientific name—*Scoliodon Sorra Kowah*; Class—*Chandropterygia;* sub-class—*Plagioston*; order—*Galea;* sub-order —*Carcharinida*; family—*Carchariniidæ*; species —*Scoliodon.*

The dimensions of the shark vary from between 30 inches to 60 inches long to between 15 inches to 20 inches broad. The livers weigh from 250 grams to 1,500 grams. The oil was obtained by grinding the minced livers with anhydrous sodium sulphate and extracting repeatedly with ether. The ether was finally distilled off and the residual oil used for analysis. The yield on the weight of the livers is about 50 per cent. of yellowish oil which, on standing, deposits stearin.

The physical and chemical constants of the oil, determined by the usual methods are given in Table I.

TABLE I

Specific gravity at 59° C.	0·9187
Ref. Index at 52° C.	1·4660
Solidifying point	21° C.
Melting point	36° C.
Acid value	0·9
Saponification value	190·9
Iodine value (wij's)	93·3

The oil was saponified with alcoholic potash and the unsaponifiable matter extracted with ether. The fatty acids liberated and purified in the usual way, gave the following constants.

TABLE II

Per cent. of mixed fatty acids	91·6
Ref. Index at 52° C.	1·4520
Titre value	37·2° C
Neutralisation value	201·7
Mean molecular weight	278·8
Iodine value (wij's)	90·3
Per cent. of unsaponifiable	2·87
Iodine value of unsaponifiable (wij's)	173·2

SEPARATION OF FATTY ACIDS

The mixed fatty acids were then separated into saturated and unsaturated acids. by Twitchell's method (1921).[3] Table III gives their analytical values.

TABLE III

Acids	% in mixed acids	Iodine value (wij's)	Mean molecular weight
Saturated	42·3	11·0	252·0
Unsaturated	57·7	149·5	264·4

Following the method evolved by P. Ramaswami Ayyar and collaborators in these laboratories (unpublished work of P.R.A.) for a more complete separation of unsaturated and saturated fatty acids, six fractions of lead salts were thus obtained:—

Fraction 'A'—lead salts insoluble in boiling hot 95 per cent. alcohol which are further separated by ether into (1) ether-soluble salts—A_1 and ether-insoluble salts—A_2.

Fraction 'B'—lead salts insoluble in the cooled 95 per cent. alcoholic filtrate from fraction 'A' which are further separated by ether into (1) ether-soluble salts—B_1 and (2) ether-insoluble salts—B_2.

Fraction 'C'—lead-salts soluble in the cooled 95 per cent. alcoholic filtrate from fraction 'B' which are further separated by ether into (1) ether-soluble salts—C_1 and (2) ether-insoluble salts—C_2.

Fatty acids were liberated from all these six fractions and their analysis is given in Table IV.

TABLE IV

Acids from fraction		%	Iodine value (wij's)	Eq. wt.
A	A_1 .	3·8	115·2	237·7
	A_2 .	4·3	12·5	248·6
B	B_1 ..	7·7	117·5	227·9
	B_2 ..	34·9	10·5	265·3
C	C_1 ..	46·4	156·3	272·0
	C_2 ..	..	..	..

The liquid acid fractions were then examined quantitatively by the Bromination method outlined by Lewkowitsch[4] and the results are summarised in Table V.

TABLE V

Bromination of liquid acids

	Ether insoluble Bromides	Petrol insoluble Bromides	Petrol soluble Bromides
Fraction A_1 3·8%			
% of A_1 acids which yield	5·4	7·3	87·3
% of bromine in the bromides	69·95	46·6	35·0
M.pts. of the bromides	Chars at 250° C.	..	liquid
Fraction B_1 7·7%			
% of B_1 which yields ..	3·5	5·0	91·5
% of bromine in the bromides	70·0	37·5	35·3
M.pts. of the bromides	Chars at 250° C.	..	liquid
Fraction C_1 46·4%			
% of C_1 which yields ..	12·4	10·6	77·0
% of bromine in the bromides	69·8	66·9	43·05
M.pts. of the bromides	Chars at 250° C.	120–35° C.	liquid
Neutralisation equivalent	918·5	..	..

The main fraction of solid acids liberated from B_2—lead salts were crystallised from 70 per cent. alcohol with an yield of 73 per cent. (m.p. 60° C., saponification equivalent 256·7).

SUMMARY

The Bombay shark liver oil has been analysed and its fatty acids separated into saturated and unsaturated components. The bromides of the latter have been prepared and analysed. The unsaponifiable matter is highly unsaturated.

My thanks are due to Prof. P. C. Guha for his kind encouragement, to Mr. P. R. Ayyar for his guidance and to (Miss) M. R. Varde for classifying the shark.

Department of Organic Chemistry,
Indian Institute of Science,
Bangalore, (MISS) INDIRA GAJJAR.
July 15, 1944.

1. *Indian Journal of Medical Research*, 1941, **29**, 279. 2. *Ibid.*, 1943, **31**, 15. 3. *Ind. Eng. Chem.*, 1921, 13, 806. 4. Lewkowitsch, "Chem. Tech. and Analysis of Oils, Fats and Waxes", 6th Edition, Vol. I, 585.

ANTIBACTERIAL AGENTS IN FLOWERS

THE works of Flemming (1929), Dubos (1939) and others definitely show that antibacterial agents can be isolated from fungi and bacteria. The subject has been ably reviewed by Waksman (1941). In a previous paper, one of us (1941) detected antibacterial agents in some crude bacterial extracts. In a recent paper Osborn (1943) has shown that such substances exist in certain green plants. Emperically flowers in various ways have been used in the treatment of diseases in this country. In this paper, we are recording our work, where we tried to find out whether antibacterial substances could be isolated from flowers. We could not make a large selection, but had to depend upon those available at our private grounds.

Extracts were made in four different ways:—(1) Water, (2) hydrochloric acid in methyl alcohol, (3) dilute ethyl alcohol and (4) glacial acetic acid.

Large quantities of flowers were dried at room temperature in the dark. These were powdered and finally extracted. The extracts were finally dried *in vacuo* at room temperature and the fine deposits used for the tests.

10 mgm. of the deposits were added to 10 c.c. of nutrient broth with 2 per cent. agar. Final pH adjusted to 7·2 and poured into 2″ diameter petri plates. Four quadrants were marked out and smeared with a young culture of the following organisms: *B. typhosus, B. coli, V. cholera* and *Staphylococcus aureus*.

The plates were incubated at 37° C. for 24 hours. The table below gives the results.

From the table, we find that the best inhibition was found with glacial acetic acid exracts. Whether this was due to antibacterial agents or other factors should be investigated. The watery extract proved negative. Selective inhibition was found with the acid methyl alcohol and ethyl alcohol extracts. The results are highly suggestive. We have not identified the active agents in the different fractions.

Organisms	Nature of extract	Rose (*Rosa damascena* N.O. Rosaceæ) Pink and Yellow	Mary Gold (*Tagetes erecta* N.O. Compositæ)	Canna (*Canna indica* N.O. Scitaminaceæ yellow, orange, pink and red)	Hibiscus (*Rosa Sinensis* N.O. Malvaceæ)	*Bignonia venesta*
B. coli	Glacial acetic acid	−	−	−	+	+
B. typhosus		−	−	−	−	−
V. cholera		−	−	−	−	−
Staphylo aureus		−	−	+	+	+
B. coli	Water	+	+	+	+	+
B. typhosus		+	+	+	+	+
V. cholera		+	+	+	+	+
Staphylo aureus		+	+	+	+	+
B. coli	Ethyl alcohol	+	+	+	+	+
B. typhosus		+	+	+	+	+
V. cholera		−	−	+	+	+
Staphylo aureus		+	+	+	+	+
B. coli	Hydrochloric acid and methyl alcohol	+	+	+	+	+
B. typhosus		+	−	+	+	+
V. cholera		−	+	+	+	+
Staphylo aureus		+	+	+	+	+

+ Growth.
− No growth.

The work requires more elaborate investigation for further informations.

Pharmacology Section,
Department of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
December 10, 1943.

B. K. BHATTACHARYA.
S. P. DE.

1. Dubos, R. J., *Jr. Exp. Med.*, 1939, **70**, 1. 2. De, S. P., *Cal. Med. Jr.*, 1941, **38**, 397. 3. Flemming, A., *Br. Jr. Exp. Path.*, 1929, **10**, 226. 4. Osborn, E. M., *Ibid.*, 1943, **24**, 227. 5. Waksman, S. A., *Bact. Rev.*, 1941, **5**, 231.

INDUCING FLOOD RESISTANCE IN PADDY BY PRE-SOWING TREATMENTS

EXPERIMENTS with a view to inducing flood resistance in paddy by pre-sowing treatments have been carried out in this laboratory for the last six years under the auspices of the Imperial Council of Agricultural Research. The basis of pre-sowing treatment has been to anticipate the deficiency of factors which plants experience in flood and to subject the activated germinal plants to such deficiency. Thus in the case of the paddy, the flooded plant presumably experiences deficiency of oxygen and light. In ordinary agricultural practice the activated germ of the paddy is subjected to light restriction under the soil but it has free access to oxygen. In our experiments the pre-sowing treatment consists in subjecting the activated germ to a period of anaerobiosis. Such treatment has been given at ordinary laboratory temperature (30°-32° C.) and then one set is subjected to low temperature (2°-5° C.).

After germination and transplantation the plants are subjected to submersions as described below. The results have been promising and the experiments are being conducted on a larger scale and according to statistical requirements. Last year's (1943-44) experiments were planned according to a statistical design suggested to us by the Statistical Laboratory of Professor Mahalanobis. The results having been encouraging are reported here.

Seed Materials—

(*a*) F. R. 27 A of Cuttack Farm — Winter paddy grown in flooded areas.
(*b*) C. No. 3 of Cuttack Farm — Winter paddy grown in normal areas.

Pre-sowing Treatments—

(*i*) *Low temperature* (*LT*).—Germinated seeds from both the varieties were placed in a kelvinator at 2°-5° C. for 6 days.

(*ii*) *Anaerobiosis* (*An*).—Another lot of the germinated seeds was kept in a continuous current of oxygen-free air for 3 days.

(*iii*) *Low temperature and anaerobosis.*—A third set of the seeds was first subjected to anaerobiosis treatment for 3 days as above and then to low temperature for another 3 days.

(*iv*) *Control* (*C*).—No treatment.

These treated and control seeds were sown in separate seedling pots and later transplanted to bigger pots with four plants of the same treatment in each pot. The pots were divided

into two sets and both the sets were submerged under water in a cemented tank (which contained clear water) one lot being submerged after 60 days from sowing and the other after 85 days. In each set there were three periods of submersion:

(a) Submerged for 15 days.
(b) Submerged for 20 days.
(c) Submerged for 25 days.

Thus the experiment consisted of all combinations of two varieties, four pre-sowing treatments, two ages of seedlings and three periods of submersion. There were three replications, making a total of 144 pots with four plants in each pot. The pots were submerged in the tank in a randomised manner according to a statistical design supplied by the Statistical Laboratory, Calcutta.

At the termination of each period of submersion the pots were taken out of water and they were first kept in a shady place for 3 days and later removed to the sun. The number of plants survived was recorded one month after removal from water. This time limit had to be fixed because soon after removal from water it was impossible to say whether a particular plant would survive or not due to its wilted and shrivelled appearance, and sufficient time had to be given to the plants to show signs of life, such as putting forth new leaves and tillers. The number of plants which flowered and their yield were also recorded and the data are presented in Tables I and II.

From the tables the order of survival, flowering and yield is as follows:

Var. F. R. 27. A—

Survival: Age =60 days—LT* + An > An† > LT > C‡
„ =85 days LT + An > An > LT > C

Flowering: Age=60 days—An > LT + An > LT > C
Age=85 days—LT + An > An = LT > C.

Yield: Age=60 days—An > LT > LT + An > C
Age=85 days—An > LT > C > LT + An

Var. C. No. 3—

Yield: Age=60 days—LT + An > LT > An > C
Age=85 days—LT + An > C > LT = An

* Low temperature † Anaerobiosis ‡ Control

From the results given above the general conclusion can be drawn that all the treatments are superior to the control in so far as survival, flowering and yield are concerned, that is to say, pre-sowing treatment does induce resistance to flood. It appears that anaerobiosis treatment alone or in combination with low temperature seems to be consistently the best treatment in the case of variety F.R. 27 A. In the case of C No. 3 which has no reputation as a flood-resistant variety, only a few plants survived on submersion, as evident from Table II. But even here, the results suggest the probable favourable effect of the treatments. It remains to be seen whether the treated plants of this variety can withstand submersion to a greater extent by increasing the duration of the treatment. The experiment is being repeated this year on the same lines.

The data collected in this experiment are being statistically analysed at the Statistical Laboratory, Calcutta, and we are very much indebted to Professor P. C. Mahalanobis for

TABLE I

Variety F. R. 27 A.

Treatments	15 days submersion				20 days submersion				25 days submersion				Total survived	Total flowered	Total yield of grains (gm.)
	No. submerged	No. survived	No. flowered	Yield of grains (gm.)	No. submerged	No. survived	No. flowered	Yield of grains (gm.)	No. submerged	No. survived	No. flowered	Yield of grains (gm.)			
AGE–60 DAYS															
Low temperature ..	12	9	9	26·32	12	10	10	26·22	12	5	5	5·78	24	24	58·32
Low temperature + anaerobiosis ..	12	12	12	29·04	12	10	7*	10·87	12	6	6	16·17	28	25	56·08
Anaerobiosis ..	12	11	11	25·79	12	11	11	21·50	12	5	5	13·14	27	27	60·43
Control ..	10	8	7	18·80	12	7	6	13·29	12	2	2	7·90	17	15	39·99
TOTAL ..	46	40	39	99·95	48	38	34	71·88	48	18	18	42·99	96	91	214·83
AGE–85 DAYS															
Low Temperature ..	12	11	10	9·51	12	8	8	14·26	12	8	8	10·17	27	26	33·94
Low temperature + anaerobiosis ..	12	11	11	12·73	12	10	7	7·57	12	9	9	6·07	30	27	26·37
Anaerobiosis ..	12	12	12	22·10	12	8	6	9·58	12	8	8	8·25	28	26	39·93
Control ..	12	8	8	17·77	12	4	3	8·06	12	3	1	1·19	15	12	27·02
TOTAL ..	48	42	41	62·11	48	30	24	39·47	48	28	26	25·68	100	91	127·26

* 2 plants which survived were destroyed by white-ants.

TABLE II

Variety C. No. 3

(No. of plants submerged for each period = 12)

Treatments	15 days submersion			20 days submersion			25 days submersion			Total survived	Total flowered	Total yield of grains (gm.)
	No. survived	No. flowered	Yield of grains (gm.)	No. survived	No. flowered	Yield of grains (gm.)	No. survived	No. flowered	Yield of grains (gm.)			
AGE–60 DAYS												
Low temperature	3	3	5·46	..	..	..	..	..	..	3	3	5·46
Low temperature + anaerobiosis	3	3	6·98	..	..	..	..	..	..	3	3	6·98
Anaerobiosis	1	1	5·39	..	..	..	..	..	..	1	1	5·39
Control	..	..	..	..	..	..	..	..	..	..	..	..
AGE–85 DAYS												
Low temperature	..	..	..	..	..	..	..	..	..	..	..	..
Low temperature + anaerobiosis	1	1	3·5	..	..	..	1	1	2·0	2	2	5·5
Anaerobiosis	..	..	..	..	..	..	..	..	..	..	..	..
Control	2	2	2·01	..	..	..	..	..	..	2	2	2·01

having undertaken the work. The design of the experiment was also supplied from the Statistical Laboratory, Calcutta, and our thanks are due to Mr. K. R. Nair for this. We are indebted to the Imperial Council of Agricultural Research for a grant which has made the experiments possible.

Botanical Laboratory,
Ravenshaw College,
Cuttack,
June 22, 1944.

P. PARIJA.
K. P. PILLAY.

A SHORT NOTE ON VERNALIZATION OF GRAM (*CICER ARIETINUM* L.)

PAL and Murty[1] in their studies on vernalization of certain crop plants found that low temperature vernalization induced earlier flowering in two out of four varieties of gram tested. Kar[2] has reported that pre-sowing cold treatment has no effect in shortening the flowering period in gram and other crops studied. A preliminary experiment was conducted here with a view to studying whether pre-sowing low temperature treatment would induce earlier flowering and higher yield in gram under Orissa conditions, and the results obtained in this connection are briefly reported below. Seeds of uniform size of variety Sabour type 4 were soaked in water for 22 hours at room temperature to initiate the dormant embryo into activity. The swollen seeds were placed in a kelvinator at 0°–2° C., one lot for 7 and another for 14 days. A set of untreated seeds was previously soaked in water to bring them to the same stage of development as the treated. Both treated and untreated were sown in separate pots on 3-12-1943 (20 pots for each treatment) with one seed in each pot. The treatment was adjusted in such a manner that the sowing was done on the same day. At the time of sowing it was observed that plumules had protruded by an average of 5 mm. in seeds vernalized for 14 days and by 3 mm. in those vernalized for 7 days and in the controls, the plumules had just emerged out of the seed-coat. The pots were arranged in an open space of the Botanical Gardens under identical conditions of light. The heights of the plants after 40 days are given below:—

Vernalized, 14 days—18·36 cms.*
Vernalized, 7 days—18·05 cms.*
Control—18·23 cms.*

(* Each value is the mean of 20 plants.)

The analysis of variance gives a small variance ratio which is insignificant and thus we might say that vernalization has no effect on the vegetative growth of the plant.

In order to study whether any earliness in flowering is induced following low temperature vernalization, the following observations were taken:—

(*i*) Appearance of first flower buds.
(*ii*) Opening of first flower.
(*iii*) Formation of first fruit.

The dry weight of the pods, which represents the yield, and the dry weight of the stem were also recorded. The entire data are given in Table I.

The data are analysed statistically and the results of the analysis are given in Tables II and III.

The results indicate that plants vernalized for 14 days flower 3 days earlier than the control ones (Table I), the difference being found to be statistically significant (Table II). There is no significant difference between the two periods of vernalization. The difference between vernalized and control plants with regard to dry weight of pods and dry weight of stem is statistically insignificant (Table III).

I have great pleasure to acknowledge my deep indebtedness to Principal P. Parija, for his kind help, valuable suggestions and helpful

TABLE I

Mean values

Treatments	Number of days taken for: formation of flower buds	Number of days taken for: opening of flowers	Number of days taken for: formation of fruits	Dry weight of pods	Dry weight of stem
Vernalized 14 days	41·40	47·15	51·85	0·293	0·976
,, 7 days	41·57	48·53	52·43	0·401	1·064
Control	44·69	50·67	55·33	0·280	1·0_8

TABLE II

Analysis of variance

Variance	Appearance of flower buds				Opening of flower				Formation of fruits			
	D.F.	M. square	F	5% F	D.F.	M. square	F	5% F	D.F.	M. square	F	5% F
1	2	3	4	5	6	7	8	9	10	11	12	13
Between treatment ..	2	58·255	7·87	3·174	2	53·105	4·125	3·178	2	56·50	4·915	3·19
Within treatment ..	52	7·401			51	12·875			48	11·496		

TABLE III

Analysis of Variance

Variance	Dry weight of stem				Dry weight of pods			
	D.F.	M. square	F	5% F	D.F.	M. square	F	5% F
1	2	3	4	5	6	7	8	9
Treatment	2	0·03725	0·348	3·174	2	0·05633	2·137	3·254
Error	52	0·10686			37	0·02636		

criticisms. I am thankful to Professor P. C. Mahalanobis for analysing the data statistically at his laboratory, and to Dr. R. H. Richaria, Economic Botanist, Bihar, for the supply of seeds.

Botanical Laboratory,
Ravenshaw College,
Cuttack,
June 22, 1944.

K. P. PILLAY.

1. Pal, B. P., and Suryanarayana Murty, G., *The Indian Journal of Genetics and Plant Breeding*. 1941, **1**, 61–85. 2. Kar, B. K., *Curr. Sci.*, 1940, **5**, 233–34.

THE ORIGIN OF THE HAUSTORIA IN THE VALUE OF *LOBELIA*

DR. G. O. COOPER (1942) has recently published a paper on the embryology of *Lobelia cardinalis* L., in which it is stated that the synergids and antipodal cells function as micropylar and chalazal haustoria respectively. The only recent work on the Lobeliaceæ and Campanulaceæ, referred to by him, is that of Kausik (1938) on *Lobelia nicotianæfolia*. Dr. Cooper has evidently missed the papers of Rosén (1932), Kausik (1935), Hewitt (1939) and some others, a study of which clearly indicates that the occurrence of haustorial synergids and antipodal cells would be most unexpected in the family.

In the absence of any material of *L. cardinalis* and the improbability of securing it for the duration of the war, the writer sectioned *L. trigona* Roxb., which is available locally. The result of this study confirms Dr. Kausik's interpretation that the haustoria (both micropylar and chalazal) originate from the endosperm and have nothing to do with the synergids or antipodal cells, which degenerate at the time of fertilisation.

It appears, however, that Dr. Kausik is not quite correct about the exact origin of the chalazal haustoria. According to him the primary chalazal cell, formed after the first division of the endosperm nucleus, divides longi-

tudinally and the two resulting cells directly produce the chalazal haustoria. My observations show that both of these cells undergo at least one transverse division and only the lower pair becomes haustorial, the upper contributing to the endosperm proper. Hewitt's (1939) observations seem to me to be more correct in this respect. He says that two cells at each end of the *eight-celled* endosperm develop into large micropylar and chalazal haustoria, the remaining four cells developing into the large central mass of endosperm.

I am grateful to Dr. S. B. Kausik (Bangalore) for a loan of some of his preparations of *Lobelia trigona*. The observations recorded here on the origin of the chalazal haustoria are, however, based on my own material as I did not find the requisite stages in Dr. Kausik's slides.

Botany Department,
Dacca University,
April 28, 1944.
P. MAHESHWARI.

1. Cooper, G. O., "Microsporogenesis and development of seed in *Lobelia cordinalis*", *Bot. Gaz.*, 1942, **104**, 72–81. 2. Hewitt, W. C., "Seed development of *Lobelia amœna*". *Jour. Elisha Mitchell Sci. Soc.*, 1939, **55** (1), 63–82. 3. Kausik, S. B., The life-history of *Lobelia trigona* Roxb. with special reference to the nutrition of the embryo-sac", *Proc. Ind. Acad. Sci.*, 1935, **B. 2**, 410–18. 4. —, "Gametogenesis and embryogeny in *Lobelia nicotianæfolia* Heyne," *Jour. Ind. Bot. Soc.*, 1938, **17**, 161–68. 5. Rosen W., "Zur Embryologie der Campanulaceen und Lobeliaceen", *Meddel. Fr. Goteborgs Bot. Tradg.*, 1932 **7**, 31–42.

A PRELIMINARY NOTE ON A FRESHWATER ENTOPROCTAN DISCOVERED IN ANNAMALAINAGAR, S INDIA

THE Entoprocta (Calyssozoa[1] or Kamptozoa[2]) are almost all marine. Two genera, *Loxosomatoides*[3] and *Chitaspis*[4] live in brackish water. The only representative in freshwater is *Urnatella* which has been found in the neighbourhood of Philadelphia,[4] U.S.A., and nowhere else in the world. It will be of great interest, therefore, to report the occurrence of a freshwater Entoproctous Polyzoan in Annamalainagar, S. India. Several specimens of this animal were collected by me a few months back, and many of them have since been under observation in the living condition in aquaria in the laboratory. I have examined a few specimens after staining and mounting, as well as in sections. I have also deposited with the Zoological Survey of India a few specimens in spirit and in mounts.

The general appearance of the animal is represented in Fig. 1. Like *Urnatella* the animal is colonial and possesses a jointed stalk with a horny covering. The colonies are about 1 mm. in height. The segments of the stalk, which are capable of functioning as resting buds as in *Urnatella*,[5] are not more than seven in number, whereas in *Urnatella*[6] there may be as many as eighteen segments in the cœnœcium. The base of the stalk has a horny disc-like expansion by means of which it is attached to the substratum. The stalks may arise singly or in clusters of two or more. In the latter case they do not have a common base as in *Urnatella*,[6] but each stalk has its own distinct base which is joined to that of the adjacent one, the bases of several stalks thus presenting together the appearance of a jointed structure.

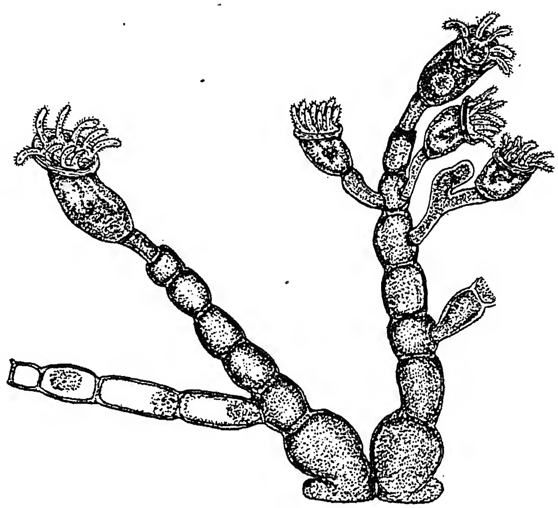


FIG. 1.—Two colonies of a freshwater 'Entoproctan' from Annamalainagar.

There is a distinct constriction between the calyx and the stalk, and the calyx is deciduous. In the specimens under observation in the laboratory, I find that the calyces are often shed and 'new heads' are grown on 'old shoulders'. Old stout stalks surmounted with very small buds are frequently met with. The calyx has no aboral shield like that in *Loxosomatoides*.[3] The lophophore is slanting and the number of tentacles is only nine, whereas in *Urnatella*[2] it is twelve to sixteen. The sphincter of the calyx is very prominent.

The general organisation of the polypide as seen in optical section is represented in Fig. 2. When the tentacles are unfolded the lophophore may be seen to surround a relatively prominent vestibule. As in the case of *Loxosomatoides*[3] there is no epistome. The alimentary canal has the usual shape found in Entoprocta. In living specimens the movement of the green contents of the stomach, due to ciliary action, is well seen. The large rectum in the extended condition and its opening into the vestibule are represented in Fig. 2. The ganglion and the gonad are made out in stained preparations, while the excretory organ is distinct in sections. In all the specimens examined by me the gonad was immature and reproduction was entirely by budding. No trace of a brood pouch has been made out so far in any of the specimens.

In the family Urnatellidæ, as described by Annandale,[4,5] *Urnatella* is the only genus which has a segmented stalk, with each segment heavily 'chitinised' and capable of functioning as a resting bud. The Entoproctan from Annamalainagar shows these features, but differs from *Urnatella* in the number of tentacles and segments of the stalk, and also to some extent in the shape of the segments, branching of the stalks and their mode of origin from the substratum.

Further work is in progress and a complete account of this South Indian Entoproctan will be published in due course.

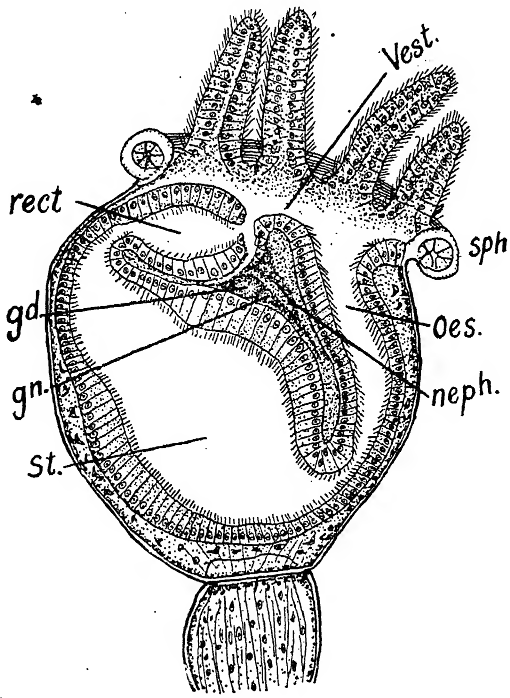


FIG. 2.—A polypide as seen in optical section, *gd.*, gonad; *gn.*, ganglion; *neph.*, excretory organ: *œs.*, œsophagus; *rect.*, rectum; *sph.*, shincter; *st.*, stomach; *vest*, vestibule.

My best thanks are due to Dr. H. Srinivasa Rao for sending me an account[6] of *Urnatella*, and to Dr. Baini Prashad for the loan of some of the references from the library of the Zoological Survey of India.

Annamalainagar, R. V. SESHAIYA.
S. India,
May 15, 1944.

1. Clark, A. H., *A New Classification of Animals*, 1921. 2. Cori, J., Kamptozoa, Kukenthal s *Handb. d. Zool.*, 1929, 2. 3. Annandale, N., *Rec. Ind. Mus.*, 1908, 2, 14. 4. —, *Mem. As. Soc. Beng.*, 1916–25, 6, 16. 5. —, *Mem. Ind. Mus.*, 1915, 5, 128. 6. Davenport, C., *Bull. Mus. Comp. Zool.*, Harvard, 1893, 24.

AN INTERESTING CASE OF DIAPAUSE IN THE CATERPILLARS OF THE CARDAMOM ROOT-BORER, *HILAROGRAPHA CAMINODES* MEYR.

IN the course of a preliminary investigation on the insect pests of cardamom in Travancore I found that a large number of full-grown caterpillars of the cardamom root-borer, *Hilarographa caminodes*, remain without feeding in a practically inactive state, for an unusually long period during the summer months till the advent of rains. This resting condition was observed only among those caterpillars that worked their way along the root into the base of the rhizome whereas those that attained full growth in the root itself pupated without delay. The phenomenon was noticed from February to April-May.

The occurrence of diapause is well known among insects and there is considerable literature on this interesting phenomenon and different workers have given various theories on its causation and the part played by the different factors associated with it. A recent work on the subject is by Prebble[1] who gives a complete review of the literature on the subject while giving a detailed account on the diapause and the related phenomena in the European spruce sawfly *Gilpinia polytoma*. In the words of Prebble (*op. cit.*), "the coincidence of resumption of development with moisture changes in the natural environment and the simulating effect of water addition either during the normal diapause period or at the time of its normal cessation clearly indicate the important role of water in most insect species". As Squire[2] says, all remote causes of diapause boil down in physiological terms to an unfavourable free-water balance. Recently I have recorded the occurrence of diapause in the developing eggs of certain Indian fishes where also water plays an important part.[3] Andrewartha[4] has shown that even the facultative diapause found in *Austroicetes cruciana* could be eliminated by subjecting it to certain temperatures which help to convert the modified yolk into a form suitable for the nourishment of the embryo and thus promoting katatrepsis. In this manner it is seen that both facultative diapause and obligate diapause are associated with nourishment. In India some work has been done on the diapause in the pink boll worm, *Platyedra gossypiella*, which has attracted attention in other parts of the world also where cotton is grown. In South India due to the absence of any extremes in climatic conditions the resting condition of the above insect is less pronounced than in the North and still less than in some other parts of the world.

It is difficult to say without further work the factor or factors responsible for diapause in the cardamom root-borer. Probably it is a case of facultative diapause as in *Platyedra gossypiella* where nutrition of the larvæ is responsible for the phenomenon. Factors responsible for diapause in the root-borer might have been indirectly induced by dry conditions since such a resting condition is not seen during the wet season. During the hot dry months some change might be brought about in the tissue of the plant thereby affecting the nutrition of the insect. How exactly this takes place cannot be said without a study of the chemical contents of the rhizome during the different parts of the year.

Central Research Institute,
University of Travancore,
Trivandrum, S. JONES.
May 23, 1944.

1. Prebble, M. L., *Can. Journ. Res.*, 1941, 19. 2. Squire, F. A., *Bull. Ent. Res.*, 1940, 31. 3. Jones, S., *Curr. Sci.*, 1944, 13. 4. Andrewartha, H. G., *Bull. Ent. Res.*, 1943, 34.

REVIEWS

Soviet Russia. By K. S. Hirlekar. (Popular Book Depot, Bombay 7). Crown octavo. Pp. xxviii + 391. Paper cover Rs. 6-8-0; Cloth bound Rs. 7-8-0.

The publication *Soviet Russia* is a compilation of information in the shape of articles by different writers, selected and edited by K. S. Hirlekar. With a Foreword by the Rt.-Hon'ble Mr. M. R. Jayakar, the book describes the progress which modern Russia has made in many periods of human activity, within a period of fifteen years.

The book is free from politics and propaganda and contains factual information supported by statistical data, and consists of five parts, each part being divided into several chapters dealing with different topics.

The first part opens with a chapter describing U.S.S.R. in miniature and introduces the reader to glimpses of the economic, mineral and power resources and the national income of Russia.

Part II has several articles on Russia's industrial might and describes the phenomenal growth of heavy and light industries, and development of communications on land, water and air.

The third part is devoted to factual statements on the phenomenal and spectacular developments in agricultural production and to the formation and functioning of State and collective farms.

In Part IV is summed up the different directions of material advance and the resulting cultural development on the mass scale.

The circumstances created by the war and the consequent effects on Russian national economy and life are described in Part V.

A perusal of the book shows how sustained effort and application of science to national reconstruction have enabled Russia to advance agriculturally, industrially and culturally within the brief space of fifteen years, and to occupy the foremost place among the nations of the world.

Abolition of illiteracy, mass technical education, establishment of numerous institutions for higher learning and scientific research, establishment of electric power stations, expansion and development of agriculture initiated and worked by the Government have produced such quick results in the economic and cultural development of the country and its people who are guaranteed education and work and wage when sound in body and health, and maintenance in old age and sickness.

In these days when there is country-wide awakening and desire for economic reconstruction the book provides stimulating reading.

B. V. N.

Systematics and the Origin of Species. By Ernst Mayr. (Columbia University Press, New York), 1942. Pp. xiv + 334. Cost $4.

This thirteenth volume in the Columbia Biological series promises to be an outstanding book and a signal contribution to the science of animal systematics. Of the many sub-branches of Zoological science, taxonomy has produced the most prolific results, but somehow has been the least respectable. This appears at once strange and sad since the essence of a clear understanding of biological phenomena is correct systematics. This has been clear from the days of Darwin who put systematics on the map and who showed the unmistakable relationship between systematics and interpretational biology. But Darwin drew no distinct line between species and infra-specific divisions and this is one of the most outstanding ways in which modern systematics differs from the old. The recognition of the importance of variations and infraspecific differences is becoming more and more common and it will probably be found in other groups of animals as it has certainly been found in birds that these differences, which, till now, used to be called minor and purposeless, have a profound bearing on the problem of the evolution of organisms. With the recognition of the importance and significance of these minor variations has developed a close affinity between the systematist and the geneticist particularly, and their combined labours have given birth to the New Systematics, a refreshingly modern version of the Old. The Darwinian faculty of interpreting simple biological facts like adaptation, variation, migration, etc., into the larger concepts of biological phenomena, drawing from them mighty conclusions on the origin of species is still there as the basis of the New Systematics as of the Old, but what the former has done is to emphasise the undoubted importance of the smaller variations in this grand process of species formation.

Dr. Mayr is particularly well suited for his task as the exponent of Modern systematics for he is himself an outstanding Ornithologist. The taxonomy of birds is the best known and it is possible that less than 2 per cent. of the number of species of birds is still unknown, and he has had unique opportunities of studying every facet of life of this fascinating group of animals, and always with a sympathy and understanding and a breadth of vision which many old systematists lacked and which has helped in his interpretation of the varied phenomena of the life of these animals. It is just this breadth of vision, just this understanding and sympathy that has enabled him to organize and marshall his observations into a coherent account of the evolutionary phenomena of animals. But it is not as if Dr. Mayr has filled his book with his own "pre-occupation". Rather, much valuable information on other groups of animals, much of what is known of the distribution and systematics and ecology of mammals, Amphibia, and insects is incorporated in what promises to be a treatise on the systematics of animals. Here is a book that ranks with Darwin's *Origin of Species* in importance, treatment and originality of conception and thought, for that is the only book we can think of as its equal. Any who reads

it will discover the similarity, will be struck by the same stupendous array of facts assembled in it. In fact, Dr. Mayr's book goes much farther and goes much deeper, and to that extent it is an extension of the study. There is no doubt that Dr. Mayr has put animal systematics on a higher and more respectable plane than it has ever been since the days of Darwin. B. R. S.

Sulfonamides. By C. M. MacLeod, P. H. Bell, H. I. Kohn, J. S. Lockwood, R. O. Roblin, Jr., J. A. Shannon and H. B. van Dyke. *Annales of the New York Academy of Sciences*, Vol. XLIV, Art. 5, pp. 445-538. (Published by the Academy, New York), Dec. 14, 1943.

The spectacular results obtained with prontosil and sulfanilamide in the treatment of the streptococcal infections started a tremendous trace all over the world to discover more active derivatives and to chart out the spectra of their therapeutic activity. So much were the results beyond expectation that immediately after a drug was found to be effective in the experimental infection, it was rushed for clinical trials even before its pharmacology was thoroughly studied. Only the outstanding results so far obtained justify this unorthodox method and impatience. Now that this race has slowed down (which is due to the paucity of additional ring systems to suit the synthesis of more sulfanilamide derivatives by the chemist) the researchers are settling down in calmness to shape the sulfonamide therapy from an emperical hit-or-miss project into a science with a rational basis. Very significant results have obtained in this direction and as pointed by Dr. MacLeod in his Introduction, "the sulfonamide drugs have been the cause of a radical change in the approach to chemotherapy, not only as it has affected their own use but that of unrelated compounds also". The papers presented in the volume under review, which is the result of a conference on Sulfonamides held by the Sections of Physics and Chemistry of the New York Academy of Sciences on April 16 and 17, 1943, are concerned with these important phases of the problem.

The volume begins with a short introduction by MacLeod. Next, Roblin and Bell present their paper on "The relation of structure and activity of sulfanilamide type of compounds" (pp. 449-54), which is a sequel to their well-known contribution on the same subject (*J. Amer. Chem. Soc.*, 1942, 64, 2905). This theory postulates that in the sulfonamide compounds, the more negative the SO_2 group, the more bacteriostatic the compound will be. The acid dissociation constants of the sulfonamides are shown to furnish an indirect measure of the negative character of the SO_2 group and an attempt is made to link the dissociation constants of the N^1-substituted sulfanilamides with their activity.

The next paper by Shannon on "The relationship between chemical structure and physiological disposition of a series of substances allied to sulfanilamide" (pp. 455-76) is of great importance. Since the sulphanilamides are being very extensively used against a variety of diseases ranging from the localised infection to severe septicemia, it is imperative to know whether the compounds used reach the specific sites in effective concentrations and are also maintained therein for sufficiently long. A knowledge of the absorption, distribution and excretion of the drugs is thus of great importance in the choice of the right drug for the treatment of a specific infection. Shannon presents very valuable data on the distribution and excretion of some thirty derivatives of sulfanilamide and closely allied compounds which are representative of typical groups and thus the data obtained regarding the changes in the absorption and distribution with the changes in molecular structure are very interesting. It is indicated that at least two factors, *viz.*, the strength of the acidic grouping and the molecular structure of the compound as a whole, are concerned with the distribution and excretion of the sulfonamides. The hope is given that "it may ultimately be possible to limit both the theatre of operation of an active substance within a series as well as the duration of the effect produced through the proper modification of the molecular structure". It is just a reasoning on these lines that has led to the evolution of sulfaguanidine and succinylsulfathiazole as intestinal antiseptics, though this represents only the first step.

In the next article on "The toxic effects of the sulfonamides" (pp. 477-502), van Dyke gives a very useful review of eighty papers on the subject which will be of great benefit to the clinicians.

"Antagonists (excluding *p*-aminobenzoic acid), dynamists and synergists of the sulfonamides" (pp. 503-24) form the subject-matter of the paper of Kohn. After an introduction which stresses the importance of the study, there is a section 'on the determination of activity' in which the method to be adopted in practice to estimate the potency of the sulfanilamides is discussed. The next section gives a very important survey of 56 papers published on the subject covering various antagonists, synergists and dynamists of the sulfonamides. The last section 'on the mode of action' contains a discussion of the mechanism of action of the sulphonamides. There is an account of the theory of Harris and Kohn of primary and secondary antagonists in which para-aminobenzoic acid is considered to be the primary antagonist while methionine, xanthine, glycine, serine, etc., the secondary antagonists.

The volume concludes with the article of Lockwood on "The action of sulfonamides in the body" (pp. 525-38) which, as the author says, 'attempts to cross the chasm that always separates the test tube from the tissues'. The subject-matter is discussed from three points of view, *viz.*, the clinical experience, the reactions of sulfonamides on bacteria growing in natural fluids of the body and those scenes of encounter between the bacteria and the host in which the sulfonamide is used as the weapon of the host. Not infrequently the author's enthusiasm bursts into poetic eloquence and the reviewer could not overcome the temptation to cite as an example his picture of one of the important limitations to the sulfonamide therapy: "If an invasive infection could be likened to a forest fire sulfonamide therapy serves as a damping rain, which suffices to check the alarming wind-

blown spread of the fire in the underbrush but does not extinguish the burning of the trees that the fire had already overwhelmed. Within a season or two the underbrush is restored, but the scarred trees remain as semi-permanent reminders of the conflagration ..... just as a rainstorm will not put out a smoldering fire in a peat-pog, so will sulfonamide therapy fail by itself to cure most of the deeply entrenched chronic infections ....." There is a discussion on the role of para-aminobenzoic acid and the article concludes with pointing out the possible avenues of investigation in future.

In short, this volume will amply repay the careful study it deserves; while the specialist in the field has a chance to check up his notes and appreciate other points of view, others interested have got a golden opportunity to get acquainted with some important phases of the subject without having to ponder through the ever-growing voluminous literature scattered in all the journals known. K. GANAPATHI.

The Purification of Water Supplies. By George Bransby Williams. (Chapman & Hall Ltd., London), 1944. Pp. ix + 83 + 4. Price 7/6 net.

This small booklet of about 90 pages is written by a Water Engineer who probably served in India, for the use of Engineers and others dealing with problems of water treatment. The title "The Purification of Water Supplies" leads one to expect an exhaustive presentation of the various aspects of modern water works practice; but the author confesses that exigencies of war, shortage of paper and other incidental difficulties have made him restrict its scope and size. This has naturally resulted in his having to condense both in matter and illustrations which has adversely affected its usefulness to a larger circle of scientists and others who are interested in water supply problems.

The author has collected information on the current methods of water supply engineering from various sources and the chapters on alum coagulation, flocculation and sedimentation give in a concise form the basic principles involved in these processes together with the recent advances in equipment and design evolved in the States and published in American literature. The chapter on sterilization and removal of tastes and odours is fairly exhaustive and incorporates the recent ideas on breakpoint chlorination; sterilization by ozone, algal control, etc.

The chemical side of the subject might have been better presented. The Engineer-author who is probably not well equipped for this task attempts to cover in about 12 pages such theoretical subjects as Valency, Electronic state of matter, Colloids, Periodic classification, etc. The major portion of the matter presented in this chapter might have been omitted with advantage and the space thus saved devoted to a study of the various sources of water and the special problems of purification connected with them. It would have been better if the author had obtained the help of a competent chemist to go through the chapter on the 'Chemistry of Water Treatment' and other portions pertaining to dechlorination and water softening. This would have helped to obviate gross errors such as (1) the mention of *sod. bisulphide* for the removal of chlorine, (2) pH below 4·4 is neutral acidity and (3) sulphur is acid to phenolphthalein. The author writes, "When Mendelyiff made his classification, there were numerous gaps in the list, and he predicted the existence of unknown elements to fill the gaps. Actually some of these elements have since been discovered. Even a tyzo in chemistry knows that not only all the missing elements mentioned by the Mendelyiff have been discovered but as a result of the classical work of Mosley, Aston, Rutherford, and others. Most if not all elements whose existence is possible have been discovered.

A reference is made to the Madras City Water Supply and the difficulty in evolving a satisfactory method of purifying it by Slow Sand Filtration to render it acceptable from the æsthetic point of view. The author's suggestion that a successful solution of the problem would be found in the American practice of superchlorination followed by dechlorination is rather amateurish, considering the vast amount of work already done on this subject by the Madras Committee on Water and Sewage Purification. The Red Hills Lake water is admirably suited for mechanical filtration but the dose of coagulant required, especially in the summer months when the lake level is low and the colloidal organic content of the water high, is uneconomical.

Some important subjects like Æration, Fluorine and its removal from water, Hexametaphosphate treatment of water for corrosion control, recent improvements in the washing of mechanical filters by a system of surface wash, are not mentioned or given the importance they deserve.

The author's description of the condition of the water supply in villages in India is only partially true; many great improvements have taken place in rural water supplies as a result of the enlightened policy followed by the provincial Governments which allotted large sums of money for the improvement of village water supplies during recent years. The author quotes extensively. He should have placed the quotation under commas. One does not know where the quotation begins and ends.

The book as is to be expected from a firm of well-known publishers, is well bound and printed; but the price of 7/6 for a small book of the size and scope seems to be excessive, even in these abnormal days of war and paper shortage. The book, however, gives in a concise form information regarding recent progress in the Science of Water Purification and may well serve as a good guide to Engineers and others engaged in the investigation and design of water treatment plants.

P. V. S.
K. V. S.

The Drainage Pattern of Mysore State. By C. S. Pichamuthu, Professor of Geology, University of Mysore. (*Journal of the Mysore University*), Vol. IV, Part XI, pp. 171-87.

Every geographer in India has to be grateful to Professor Pichamuthu for the lead he has

been giving to others in the elucidation of the geomorphology of Peninsular India. The need for such type of work was being felt since a very long time.

The drainage pattern of Mysore is a little peculiar when compared with the general trend of drainage in Peninsular India. Professor Pichamuthu traces a relationship between the alignment of rock formations and the river systems of Mysore. The schists composed of the ferruginous quartzites and quartzites are found to be more resistant thus influencing the trend of the tributaries of the peninsular rivers as compared with the gneisses of the region. The universal law of differential weathering has been clearly indicated. The different type of topography exhibited by quartzites and gneisses of Mysore is similar to the one seen in the Nagari area.

The rivers of Mysore generally have a N.-W. and S.-E. trend in the west, N.-N.-W. and S.-S.-E. trend in the middle and northerly and southerly trend in the eastern position of the State. The only exceptions are the Tunga, Bhadra. Vedavati and Cauvery. Of these Vedavati has a number of gorges cutting across the resistant schists, but flows northwards when it meets the Closepet granite. Cauvery, since it flows in a gneissic country, has a general easterly trend.

The above type of arrangement is explained by Professor Pichamuthu as due to a dome with a central axial line of elevation running in an E.-W. direction across the State. The subsequent deviations in the trend of rivers are assigned to the subsequent elevation of the Western Ghats.

The remarkable east-west divide does not seem to have a structural basis. This may be either a superimposed feature or it may be due to dislocation in the northern and southern portions of the State. More evidences are required to indicate the uplift of the Western Ghats subsequent to the alignment of the drainage pattern. The rivers at the west, on the plateux and on the plains of the coast belong to different cycles of erosion and the pattern has to be studied from the source to the mouth. In this connection Cushing's[1] paper and the paper on the Palar[2] basin will give us some insight. Cushing considers most of the regions indicated in this paper as portions of an elevated peneplain.

Professor Pichamuthu is giving an impetus to Indian physiographers by the work that he has been doing and we look forward to an elaboration of many of the suggestions made in his paper. B. VARADARAJA IYENGAR.

1. "The East Coast of India" S. W. Cushing, *Bulletin of American Geographical Society*, 1913. 2. *Journal of the Madras Geographical Society*.

MINERAL NUTRITION OF PLANTS*

RECENT advances in our knowledge of plant nutrition have undoubtedly formed one of the important scientific foundations of modern crop production. Plant tissues are dominantly organic in nature once the water is driven off. Hence, the real problem of plant nutrition, from the point of view of the plant, is not, strictly speaking, a problem of inorganic nutrition but one of organic nutrition. What we should like to learn about the inorganic nutrients is how, directly or indirectly, they enter into the synthesis and utilization of organic compounds. Thus far, our knowledge of the functions of inorganic nutrients, except as they are present as components of the structure of indispensable organic compounds, has been very scanty. More recently, however, the application of the principles and techniques of biochemistry to plant nutrition has yielded a corpus of integrated knowledge on the mineral intake and metabolism of plants. A good deal of this knowledge has come from Dr. Hoagland's flourishing school of research at California, represented by numerous publications during the last quarter century. Workers in this field of research will, therefore, keenly welcome the publication of these lectures, seven in number, which, given originally at the Harvard University under the Prather Lectureship, present a general perspective of several important aspects of plant nutrition. The book is illustrated with many tables, text-figures and photographs of excellent quality and a selected bibiliography is appended to each lecture. Most of the illustrative material is drawn from the experiences of the Californian group of workers. It is but natural that, in lectures of the present type and objective, the author should have emphasized on the work with which he has had the most direct contact.

The first lecture introduces the reader to a brief survey of the soil-plant-air system with its innumerable interrelations and interreactions. The early theory of Liebig that the fertility of the soil does not rise and fall in exact proportion to the mineral elements withdrawn from or added to it has given place to the present-day dynamic interpretation of the soil as an ever-changing system, biologically controlled by the activities of the micro-organisms and of the higher plants growing in the soil. On this assumption, the concept of "supplying power" of the soil and the interrelation of the solid to the liquid phase of the soil become considerations of paramount significance in understanding the nutrient capacity of the soil.

The second lecture is devoted to a resumé of the development of knowledge of certain chemical elements needed by plants in minute amounts. The author has appropriately used the term "micro-nutrient" to cover these elements, hitherto called by students of plant nutrition variously as "rare", "minor", or "trace" elements. The functions of these elements, effective in minute amounts in plant growth and metabolism, are, however, still in a large measure obscure, although there is little

* *Lectures on the Inorganic Nutrition of Plants*, by D. R. Hoagland (The Chronica Botanica Co., Waltham, Mass.; Macmillan & Co., Ltd., Calcutta), 1944, pp. 226. Price $ 4·00.

doubt that they act in some not altogether well understood way as biochemical catalysts. Thus, zinc, deficiency of which results in a marked effect in retarding protein and, to a less extent, starch synthesis, may be a component of a catalytic system necessary for the phosphorylation of glucose (known to be a step in starch synthesis) or possibly of an amino acid. Likewise, boron requirement may arise on account of its role in the formation of pectic compounds: these contain galactose derivatives which require an inversion of H and OH on one of the C atoms if they are formed from glucose, this inversion being possibly brought about by boron. Several phases of organic metabolism need exploration before the exact mode of action of the different "micro-nutrient" elements is elucidated.

Another aspect of the problem of "micro-nutrient" deficiencies concerns their relation to animal nutrition. The requirements of the plant and of the animal are not necessarily coincidental quantitatively and not always qualitatively. Our knowledge of the factors that govern the quality of plant products from the point of view of human and animal nutrition is greatly limited but doubtless we should expect many unifying principles of metabolism common to living organisms of different categories. The "micro-nutrient" elements present an interesting aspect of these convergent investigations.

The mode of entry into the roots of the essential chemical elements and their upward movement and distribution in the plant are dealt with in the next two lectures. Radioactive isotopes or tagged ions have been of great value as a tool in these investigations inasmuch as they can indicate their presence in most cases without any operation on the plant, by application of a Geiger-Müller Counter and by radio autographs to the undisturbed tissue. It is now known that the intake of the nutrient ions is not, as many text-books have taught us, merely a diffusion process proceeding to attainment of equal concentrations or activities of a solute in internal and external phases, and that ion intake often takes place against gradient concentrations, this capacity being of course dependent on metabolic activities of the cell by which cellular energy is made available for ion transport.

A large portion of the nutrient salts absorbed is translocated to the upper part of the plant, there to serve the functions of growth and metabolism in the various above-ground organs. At one time, this upward movement of salt was, at least by implication, regarded by many botanists as a simple matter, transpiration being frequently assumed to play a determinative role therein. Recent evidence, much of it adduced by the author and his collaborators, would suggest that the absorption of salt and the absorption and transpiration of water are independent processes and that salt does not move in a plant merely in relation to the water absorbed. Essentially, salt absorption and movement are determined by the metabolic activities of the plant which are dependent upon the availability of energy-containing compounds or special organic units, and of substances catalysing or regulating metabolism, for all of which photosynthesis is ultimately necessary. Our knowledge of salt movement in the plant is still inadequate although the data reported permit a much closer approximation to an understanding of these phenomena than has been available in the past. One especially interesting aspect for study with regard to solute movement in plants will relate to the so-called "flow-back" of nutrients from the plant to the soil for which satisfactory experimental evidence is apparently lacking, although it is known that something like a circulatory movement of mobile inorganic nutrients can take place in the plant by which solutes are carried in the wood to foliar regions from which they may be re-exported through living cells even back to the roots.

The fifth lecture discusses some of the physiological aspects of the inorganic nutrition of plants as they are offered for examination under the controlled conditions of artificial culture technique (water culture, "hydroponics", sand culture, and gravel culture). These have certainly been of great service as tools for research in plant nutrition and, in recent years, have attracted an extraordinary amount of attention as a means not merely to study general scientific principles of plant nutrition but also to produce crops commercially. Many, among the uninformed, seem to gain the impression that a revolutionary development has taken place and that soon we could dispense with soil as medium for crop-growth on large scale. It should be distinctly borne in mind, however, that, save in unusual situations, artificial culture methods are at present applicable in a commercial way only to expensive green house crops. Even there, practical and economic factors should receive critical consideration before their adoption can be justified.

The chemical processes occurring in plant tissues as salt is moving into or through the cells, or soon after the salt has been accumulated are not well understood and the author discusses in his sixth lecture several aspects of the problem with special reference to the nitrogen and organic acid metabolism of higher plants. Progress in understanding the metabolism of plant-cells in relation to salt accumulation will depend largely on advancing knowledge of the biochemistry of respiration, together with a correlation of biochemical transformations with the maintenance of organized structures in the protoplasm.

The concluding chapter presents an illuminating discussion of the potassium nutrition of plants both in relation to soil problems and the functions of potassium in plant metabolism. These studies serve well to illustrate the ramifications of research in an attack on any general problem of plant nutrition and the need of many approaches to proceed towards a goal of increased understanding of soil-plant interrelations.

As the author has pointed out in his prefatory note, these lectures do not have the characteristics of a monograph or a text-book but it is not the least of the merits of Professor Hoagland's exposition that they are both authoritative and inspiring.

A. SREENIVASAN.

SCIENCE NOTES AND NEWS

Chinese scientists are taking their full share in their country's war effort. Cut off from contacts with scientific research in the rest of the world they work under conditions of the utmost difficulty and hardship, yet produce remarkable results. The physics section of the Peiping Academy, which made the long journey from occupied territory to Free China after the Japanese invasion, has turned over almost wholly to war production. A plant for grinding lenses for microscopes and telescopes has been set up, and the Academy is actually producing microscopes for teaching and research, having worked out all its own necessary apparatus. All the optical glass for this plan is supplied by Britain. The Chinese have developed entirely new methods for making quartz piezo-electric crystals for frequency stabilisation in radio work. These are being produced in regular quantity so that a supply may be available at need for the other United Nations. Dr. Tsien Ling-Chao, Director of the Physics Section, has based some of his methods on the optical work of a Chinese philosopher, Mo-Tze, who lived 400 B.C.

An atmospheric research committee has recently been constituted under the ægis of the Council of Scientific and Industrial Research to investigate problems connected with the upper air. Dr. M. N. Saha of the Calcutta University is the Chairman of the Committee and its members include Dr. C. W. B. Normand, Prof. H. J. Bhabha, Dr. D. S. Kothari, Dr. S. K. Banerjee, Dr. S. M. Isaque, Prof. S. Bhagavantam and Dr. K. R. Ramanathan.

Dr. Mortimer Wheeler, Director-General of Archæology, Government of India, has suggested the formation of a National Museum in a central place in India which would provide a complete conspectus of Indian civilisation during the past five thousand years or more, an institution which would be the Indian counterpart of the British Museum.

The Indian Lac Cess Committee at its recent meeting has decided to appoint a lac information officer for India for the purpose of unifying the publicity, propaganda and administration work of the Indian Lac Research Institute and for establishing trade contacts within the country.

Experiments carried out at the Forest Research Institute, Dehra Dun, indicate that tar acids of Indian origin are suitable for the preparation of resin adhesives. These are important in the manufacture of high grade plywood whether for marinecraft or aircraft or for any other purpose where high grade strength complete freedom from attack by fungi and water-proof qualities are of importance. Imported resin adhesives being short of supply, the work done on resin adhesives of indigenous origin in the Wood Preservation section of the Institute has been published.

The Government of Madras have directed that a Provincial Post-War Reconstruction Committee be constituted with the Adviser in charge of the Development Departments as Chairman and the Secretary to Government, Development Department, and the Director of Industries and Commerce, Joint-Director of Industries and Commerce, the Director of Agriculture and the Officer in charge of the Geological Party in Madras, and the Chairman, National Service Labour Tribunal, Madras, as members. The Special Development Officer will be the Secretary of the Committee. The Committee will be entrusted with the task of preparing plans for he reconstruction based on knowledge and information now available and capable of being executed within the measurable time of five to ten years immediately after the war.

An Advisory Mission of Machine Tool Utilisation Experts from United Kingdom, headed by Sir William Stainer, F.R.S., a former Chief Mechanical Engineer of the London, Midland, and Scottish Railway Company, and Scientific Adviser, British Ministry of Production, is shortly visiting India to advise the Central Government on the measures to be taken to ensure that the fullest use is made of the available engineering plant and machine tools in India. Other members of the Mission are: Mr. A. N. Jervis. from British Railways Staff; Mr. W. H. G. Clifton, Production Engineer, Ministry of Aircraft Production; Mr. B. W. Palmer, Manager of Railway Department of Messrs. G. D. Peters, Nr. Slough; and Mr. I. V Woolley, Machine Tool Control, British Ministry of Supply.

The University of Texas, U.S.A., announces the discovery of two new vitamins which may possess properies helpful in the control of anæmia and nervous disorders.

Thirteen students, including a lady, from nine universities all over India have been awarded scholarships from the J. N. Tata Endowment for higher education abroad. Eight of them are proceeding to the United States, four to Britain, and one to Canada. The recepients of the scholarships are:—Mr. A. K. Dutt (Dacca), Mr. N. Sreenivasan (Madras), Mr. H. K. Joshi (Benares), Mr. B. D. Tilak (Bombay), Dr. D. N. Solanki (Benares), Mr. S. S. Cardmaster (Bombay), Mr. Rajendra Singh (Calcutta), Mr. K. Subramaniam (Madras), Mr. Raiz Ahmad (Aligarh), Mr. Lalit Prasad (Patna), Mr. N. K. Ananthanarayana Aiyar (Mysore), Mrs. K. Sunanda Bai (Indian Institute of Science) and Mr. Amol Rattan (Punjab).

Dr. Sadgopal, Chief Chemist, Messrs. The Hindustan Aromatics Co., Naini, Allahabad, who has been invited by the Chief Editor, *Dictionary of Economic Products and Industrial Resources of India*, to contribute an article on "Perfumery Industry in India", writes to us as follows:—"The proposed contribution by me shall have to include information on the following points: (i) History of the industry, (ii) Raw materials—place or places of availability, quantity and quality, (iii) Capital, labour, number and location of factories, with their addresses, (iv) Manufacturing processes employed, (v) Variety and quality of products manufactured, (vi) Markets at home and abroad, (vii) Future developments, (viii) Value of total local production, imports and exports for the last ten years, (ix) Any research work carried or in progress. I have the honour to invite you, therefore, to be good enough to send me all information in your possession on the lines suggested above. Due acknowledgments shall gladly be made wherever necessary and permitted by the sources of information. I shall deem it a favour if you will be so good as to make a due acknowledgment of this letter and send me the necessary data *before the middle of August* 1944.

The Government of India have sanctioned a scheme of scholarships for students belonging to the scheduled castes who wish to pursue their studies in scientific and technological subjects beyond the Matriculation stage. The total amount awarded every year will be Rs. 3,00,000.

The scheme which aims at improving the educational and economic conditions of scheduled castes will have immediate effect. The number of scholarships to be awarded and their amount has not yet been fixed, but the amount awarded will cover the entire cost of education including fees, cost of books and in the case of residential scholars their maintenance charges. Some of these scholarships will be given for studies in India and some in foreign countries.

For courses commencing in 1944 applications are being called through Directors of Public Instruction, Superintendents of Education and Vice-Chancellors of Universities. All the scholarships in 1944-45 will be for studies in India. Arrangements for students to proceed abroad are expected to be made next year.

SEISMOLOGICAL NOTES

(January-June)

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory during the period January-June 1944, there were three of great, five of moderate and four of slight intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T. H.	M.	Epicentral distance from Bombay (Miles)	Co-ordinates of epicentre	Depth of focus (Miles)	Remarks
Jan. 6	Moderate	03	43	2390	Lat. 3°·5 S., Long. 99°·5 E. near Sumatra.		
16	Moderate	06	20	9850			Felt in Argentine. Serious damage in San Juan.
Feb. 1	Great	09	52	3115	Lat. 41°·8 N., Long. 25°·8 E.		Felt in Turkey. Great destruction in Gerede.
29	Great	22	58	1390			Epicentral region near the Maldive Islands. Tremors felt in Ceylon and Madura.
Mar. 10	Moderate	04	33	1940			
15	Slight	11	34	1490	Lat. 41° N., Long. 75° E. near Samarkaband.		
22	Slight	07	13	3960	Lat. 4° S., Long. 127° E. in Banda Sea.	125	
Apr. 10	Slight	10	03	1060			
26	Moderate	08	24	4415	Lat. 2°·4 S., Long. 135° E. in Geelvink Bay, Dutch New Guinea.	62	
27	Great	21	08	4290	Lat. 7° S., Long. 131° E.		
May 25	Moderate	19	28	5100		62	
30	Slight	16	25	1520			

801-44—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

THE BANGALORE PRESS

CURRENT SCIENCE

Vol. XIII] AUGUST 1944 [No. 8

POST-WAR DEVELOPMENT OF INDIAN FISHERIES

INDIA'S resources of fisheries are rich and extensive. The Bay of Bengal and the Arabian Sea are abundant in tropical species of food-fishes. Besides the marine fisheries, the inland waters such as the rivers, lakes and tanks abound in good fish and constitute a substantial source of food supply. Unfortunately, no serious attempts have been made to develop and exploit these fisheries. Fishing is, no doubt, practised by the coastal fishermen but their fishing craft is primitive and the mode of disposal of fish unscientific and uneconomical. Fish is hardly supplied a few miles interior of the coastal line. In spite of the poor fishing methods used by the fishermen the average quantity of fish landed by a fisherman on the Malabar Coast works out to seven tons a year which exceeds the corresponding average for the Japanese fisheries. This instance is cited to emphasize the richness of the West Coast fishery. But the total catch of the whole of India which is estimated to be 7,000,000 tons per year is shockingly poor compared with the vast population of the country.

Pioneer workers in the field of fishery development in India such as Dr. Francis Day, Sir Frederick Nicholson, Sir K. G. Gupta, Dr. B. Sundara Raj, Dr. S. L. Hora, and others have repeatedly pointed out the backward condition of the Indian fisheries and have urged the importance of organising fishery development and fishing industry. The Royal Commission on Agriculture in India have observed, "We have been greatly struck by the comparative failure to develop the fisheries of the country . . . The addition of fish to the diet of the cultivator seems to be the most promising way of securing that improvement in his nutrition which is so much needed and all measures practicable to this end should be taken". The Overseas Committee of the Indian Science Congress Association has stressed the need for the formation of a Central Executive Fishery Research Council working under one of the departments of the Government of India and the establishment of a Fishery Research Institute for the proper development and conservation of the valuable fisheries of Indian waters. In a memorandum (Government of India Press, New Delhi, 1944), Dr. B. Prashad has made similar recommendations as those of the Overseas Committee and has given a five-year plan for the development of fisheries in India with particular reference to the importance of scientific research both biological and technological. An account of the prawn fisheries of India and their importance as sources of food production has been given by Dr. B. Chopra in his Presidential Address to the Indian Science Congress (1943). It is gratifying to note that the importance of fishery development is being felt in different parts of India. Some basic work has already been done in Bengal, Madras, Bombay, Punjab, Travancore, Mysore, Hyderabad and Baroda. It is true that so long as the fisheries is a "transferred" subject the main responsibility of organising and exploiting the fisheries rests with the provincial and state governments, but the problems connected with the fishery development in India as a whole are so varied and complicated that they cannot be solved without proper co-ordination and financial assistance by a strong Central Advisory Body in Government of India. The Overseas Committee in recommending the formation of such a body have rightly observed, "Many fishery problems are, moreover, common to several provinces, or, indeed, to the whole of India, and to attempt their solution by a number of poorly staffed and disconnected units—even if it were possible—could only result in overlapping and in wasted efforts". The establishment of the Fishery Research Institute and the Advisory Fishery Research Council as suggested by Dr. Prashad is as urgent as it is essential for the successful solution of the basic problems of fishery development.

There are numerous difficult problems to be solved in connection with the development of Indian fisheries. Dr. Prashad states, "The intricate problems concerned with the proper development and exploitation of the fisheries are often so much more difficult of elucidation and solution than in other industries, that only a carefully planned, long-term scheme of research and experimental work would seem to meet our difficulties. Various physical and biological factors which influence the abundance or scarcity of fishes in any maritime area are depth, temperature and salinity of the water, nature of the bottom, weather conditions, state of the tide, time of the day, season of the year, migrations of the fishes following those of organisms which form their food or in response to reproductive instinct, and several other factors. In European and American waters, sustained and well-directed research by large bands of trained marine biologists of all nations extending over many years has gone a long way towards elucidating the relative influences of nearly all these factors, and making available detailed information on the biology, age, life-histories, food, rates of growth, migrations, etc., of most of the important food-fishes. No such data are available for Indian species of marine fishes. There are similar problems in regard to the freshwater and estuarine fisheries of India awaiting solution, but no real progress is possible until accurate and detailed information on these basic points becomes available." Other problems connected with the fishing industry relate to the adoption of deep-sea fishing, devising better fishing craft and fishing appliances, organising curing, smoking, canning, refrigeration, quick transportation, marketing of fishes and such others. Further there is the problem of organising subsidiary industries such as the manufacture of fish-oils, guano and fish-meal. It may further be pointed out that the hydrographical and biological conditions of the fisheries and the habits of fishes in our tropical waters are so different from those in the Western countries that a blind application of the Western fishery principles to solve these problems may prove inadequate and often useless. It is, therefore, necessary that each problem has to be carefully studied with particular reference to local conditions and appropriate solutions found.

The magnitude of the importance of fishery development in India cannot be over-emphasized. No dietetic improvement can be planned for the people of India without a programme for the rational exploitation of its fishery resources. The various provincial and the state governments in this country particularly the Central Govenment should devote its earnest attention to the subject of fishery development and give the subject an important place in their Post-War Planning.

Till such time as the Central Advisory Fishery Research Council and the Fishery Research Institute are formed, the scope of the "Fish Committee" of the Imperial Council of Agricultural Research may as well be widened to secure an effective and fruitful co-ordination of fishery investigations among different provinces and states. The Fishery Experts in different parts of India should be invited to serve on the reconstituted and enlarged committee. They have acquired an intimate knowledge of the present condition of the fisheries in their respective provinces and states, which will be very helpful in formulating a correct policy regarding the organisation of fishery development in India. Important investigations can immediately be started with the co-operation of fishery departments and scientific institutions in the country. The Madras Zoological Research Laboratory has recently carried out some outstanding work and with additional staff and equipment, the Institution will no doubt be able to successfully solve marine biological problems connected with fishery research. Similarly the Marine Biological Stations at Trivandrum and West-Hill can conduct such investigations on the West Coast. The example of the Department of Zoology of the Calcutta University which has worked out certain fishery problems, is worthy of emulation by other universities in India.

NUTRITIVE VALUE OF DEHYDRATED VEGETABLES

DEHYDRATED vegetables are now being manufactured in large quantities in many belligerent countries and it is important that their nutritive value should be studied. A good deal of work on this subject has been carried out in the Indian Research Fund Association Nutrition Research Laboratories, Coonoor, under Dr. W. R. Aykroyd, says the report of the Scientific Advisory Board of the Indian Research Fund Association for the year 1943.

Steam-blanched cabbage was found to lose vitamin C more rapidly on storage than cabbage blanched by dipping in boiling water. Loss of vitamin C in dehydrated vegetables prepared by the so-called "pre-cooking" method was more rapid than in vegetables prepared by other processes. The general conclusion arising out of a considerable amount of work on the vitamin C content of dehydrated vegetables is that these cannot be relied upon as antiscorbutics after a period of a few months' storage.

While carotene is somewhat more stable than vitamin C in dehydrated vegetables, very appreciable losses occur on storage. After 20 weeks' storage at 98° F., bitter gourd, cauliflower, carrot, pumpkin and potato lost from 35 to 65 per cent. of their original carotene content. Losses in the mineral content of dehydrated vegetables during reconstitution and cooking amounted to 60 per cent. When in the U.S.A., attending the United Nations Conference on Food and Agriculture, Doctor Aykroyd collected considerable literature on the effect of dehydration on the nutritive value of vegetables and other foods, a subject which is being intensively studied in England, Canada, the U.S.A. and Australia.

GLANDS AND GLAND PRODUCTS

IV. Seasonal Variations in the Total Iodine and Thyroxine Contents of the Thyroid Glands of South Indian Animals

BY

B. B. DEY, P. S. KRISHNAN AND M. GIRIRAJ

(Presidency College, Madras)

THE thyroid stands unique amongst all the endocrine glands as regards susceptibility to geographic and seasonal variations. Glands from animals belonging to certain regions (especially the so-called 'goitrous regions') have been shown to contain very low iodine in marked contrast to the high iodine content reported for South Indian animals (Dey *et al.*).[1] That there is a marked seasonal variation in the iodine content of the thyroid was established by Seidell and Fenger[2] and by Fenger[3] who analysed thyroid glands of hog, beef and sheep collected from the Mississippi valley and showed that during the summer months the glands might contain as much as three times the amount of iodine in the winter months. This observation has been confirmed by Veil and Sturm[4] and also by Kendall and Simonsen[5] who showed marked seasonal variations not only in the total iodine but also in the amount of thyroxine which could be isolated. The extensive investigations carried out by Riddle[6] on the thyroids of doves have shown marked changes in the weight and iodine content of the gland with changes of season. Remarkably enough, Scottish and English animals show a fairly constant iodine content for desiccated thyroid throughout the seasons of the year.[7]

Two theories have been put forward to explain this seasonal variation in the iodine contents. Cameron[8] and his school are of opinion that the predominant factor is the diet; during summer months the animals have free access to pastures whereas during the winter months they are confined indoors and fed on artificial diet. This theory is supported by numerous observations that the iodine content of thyroid can be artificially increased by feeding on diet rich in iodides (*cf.* Hunter and Simpson).[9] Fenger,[3] however, has suggested that the temperature factor is the most important of all in producing seasonal variation in the iodine content of the thyroid. There is an increased metabolism at lower temperatures and more of the hormonal secretion is poured out from the gland thereby depleting the latter of its iodine reserves; these effects are reversed during the summer months. This theory finds support in the experimental observations of Mills[10] who found that high temperatures cause diminished activity of the thyroid and of Cramer[11] who showed that response to cold increases thyroid activity.

This seasonal variation in the iodine content of the thyroid glands has more than theoretical significance. Kendall[12] has pointed out that for the isolation of thyroxine the thyroid material available in the United States from the months of October to June is not practicable from a commercial point of view; in June, July and August the amount of thyroxine may be almost five times as much as the amount which can be isolated from the same weight of hog glands in January and February.

The thyroid glands of cattle, sheep and pigs available from the Madras Corporation Slaughter House were collected during the twelve months, August 1943 to July 1944, desiccated and analysed for total and thyroxine iodine by standard methods. The results, which are represented in the following table,

TABLE I

Analysis of Thyroid Glands (desiccated) collected during the twelve months of the year

Month	Animal	Total Iodine (per cent.)	Thyroxine Iodine (per cent.)	% Ratio Thyroxine Iodine / Total Iodine
August 1943	Cattle	0·9113	0·3530	38·75
	Sheep	0·6650	0·2593	38·99
	Pig	0·9150	0·3904	42·67
Sep[r].	Cattle	0·9492	0·3861	40·67
	Sheep	0·7060	0·2959	41·91
	Pig	0·8314	0·3869	46·54
Oct.	Cattle	0·9642	0·3533	36·64
	Sheep	0·6479	0·2669	41·29
	Pig	0·8949	0·3949	44·14
Nov.	Cattle	0·9429	0·3620	38·39
	Sheep	0·6321	0·2607	41·24
	Pig	0·8590	0·3639	42·36
Dec.	Cattle	0·9772	0·4045	41·39
	Sheep	0·6648	0·2770	41·67
	Pig	0·8325	0·3622	43·70
Jan. 1944	Cattle	0·9917	0·3964	39·96
	Sheep	0·7237	0·2904	40·14
	Pig	0·8181	0·3487	42·62
Feb.	Cattle	1·030	0·4041	39·23
	Sheep	0·7602	0·2924	38·47
	Pig	0·7833	0·3155	40·27
March	Cattle	0·9647	0·3691	38·25
	Sheep	0·7496	0·2678	35·72
	Pig	0·7715	0·3736	48·42

TABLE I—(*Contd.*)

Month	Animal	Total Iodine (per cent.)	Thyroxine Iodine (per cent.)	% Ratio Thyroxine Iodine / Total Iodine
April	Cattle	0·9552	0·3590	37·58
	Sheep	0·7127	0·2636	36·99
	Pig	0·5664	0·3032	53·53
May	Cattle	0·9839	0·3420	34·75
	Sheep	0·7476	0·2716	36·33
	Pig	0·8038	0·3271	40·69
June	Cattle	0·9954	0·3623	36·40
	Sheep	0·7962	0·2913	36·59
	Pig	0·8109	0·3411	42·07
July	Cattle	1·052	0·3638	34·58
	Sheep	0·7678	0·2903	37·80
	Pig	0·8260	0·3432	41·56

indicate that there is practically no seasonal variation in the total or thyroxine iodine content of the glands.

Glands collected all round the year in South India can, therefore, be utilized for the preparation of thyroxine and thyroid extracts.

The expenses of these investigations were met by a grant from the Board of Scientific and Industrial Research, to whom our grateful thanks are due.

1. Dey, Krishnan and Giriraj, *Curr. Sci.*, 1943, **12,** 272. 2. Seidell and Fenger, *J. Biol. Chem.*, 1913, **13,** 517. 3. Fenger, *Endocrinology*, 1918, **2,** 98. 4. Veil and Sturm, *Deutsh. Arch. Kl. Med.*, 1925, **147,** 166. 5. Kendall and Simonsen, *J. Biol. Chem.* 1923, **80,** 357 6. Riddle, *Amer. J. Physiol.*, 1925, **73,** 5; *Endocrinology* **1927, 11,** 161. 7. Martin *Pharm. J.*, 1912, **89,** 169, **444.** 8. Cameron, *J. Biol. Chem*, 1915, *J. Biol. Chem.*, **23,** 1. 9. Hunter and Simpson, *J. Biol. Chem.*, 1915, **20** 119. 10 Mills, *Endocrinology*, 1932, **16,** 52. 11. Cramer, 'Fever, heat regulation, climate and the thyroid-adrenal apparatus,' 1928. 12. Kendall, '*Thyroxine*', 1929.

THE SUGAR RESEARCH FOUNDATION

A LONG-RANGE programme of research on sugar will be undertaken at the Massachusetts Institute of Technology in co-operation with the newly established Sugar Research Foundation of New York, which has made a grant of $125,000 for a five-year programme of research. Plans for the project were made public in a joint announcement by President Karl T. Compton, of the Massachusetts Institute of Technology, and Joseph F. Abbott, President of the Sugar Research Foundation.

The Foundation was established for the development of fundamental knowledge in the field of carbohydrate chemistry, biochemistry and nutrition. Membership is open to all producers and processors of sugar in the United States, Puerto Rico, Hawaii and Cuba.

Dr. Compton, in announcing the co-operative arrangement, said:—

"The new programme is another step in the Institute's long-established policy of co-operation with industry in fundamental research to improve industrial processes and develop new products. The project we are about to undertake is a pioneering plan of national significance in that it promises substantial benefits, not for one organization, but for an entire industry.

"The rewards of scientific research in co-operation with industry are by no means restricted to the development of new products, for the discovery of new knowledge in any branch of science invariably proves to be a contribution to advanced technical education in associated fields. Thus this sponsored research on sugar makes it possible for the Institute to continue and expand the programme of fundamental investigations in the field of carbohydrate chemistry which has been in progress for several years.

"We are particularly glad that Dr. Robert C. Hockett, who has been given leave of absence from our Faculty to become the scientific director of the Sugar Research Foundation, will be in charge of this broad programme.

"The sugar industry is to be commended for its public service and vision for making possible this objective research. I feel sure it will be rewarded by results of great scientific value to the public."

Commenting on the new laboratory, Joseph F. Abbott, President of the Sugar Research Foundation, said in part:—

"It is anticipated that the chemical studies conducted under the arrangement with the Massachusetts Institute of Technology will not only extend knowledge of the rôle of sugar and other carbohydrates in the human body, but also will unfold wholly new industrial uses for sugar and its derivatives. It is our hope that the collaboration between the industry and this outstanding technical Institution will prove to be of great benefit to science and the general public as well as to the industry.

"An important objective of this broad research programme will be the training of scientists in the field of carbohydrate chemistry to prepare them for service in the industry for further technical studies. Provision has also been made for fellowships for young graduate students who are candidates for advanced degrees to permit them to continue their work in this field."—*Science*, December 10, 1943, p. 509.

LETTERS TO THE EDITOR

THE P.A. FACTOR AND PHENYLHYDRAZINE ANÆMIA

EXPERIMENTAL animals made anæmic with phenylhydrazine have been used for some time in this laboratory for the study of the hæmopoietic action of amino-acids and proteins with very satisfactory results (Yeshoda, 1942[1]; Damodaran & Vijayaraghavan, 1943[2]; Yeshoda, 1943[3]). It occurred to us to investigate if the method could not be used for the biological assay of the factor present in liver extracts active in pernicious anæmia (hereafter referred to as the P.A. factor) for which no satisfactory method at present exists. Similarity of the blood pictures in pernicious anæmia and experimental phenylhydrazine anæmia has been frequently noted (cf. Paton and Goodall, 1903[4]; Price Jones, 1911[5]). Erdos (1935)[6] has shown that in rabbits made anæmic by means of phenylhydrazine the onset of anæmia is delayed by the administration of liver extract and has suggested the utilization of this effect for comparing the potency of such extracts. On the contrary Wright and Arthur (1930),[7] who also experimented upon rabbits, came to the conclusion that *"the regeneration from anæmia resulting from the injection of phenylhydrazine or from hæmhorrhage is not affected by the administration of the substance effective in pernicious anæmia".*

In the present experiments it has been found that liver extract exerts a markedly beneficial effect on the recovery of rats from phenylhydrazine anæmia. All the animals received a basal diet containing 3 per cent. casein which has been shown in previous experiments to be the minimum amount of protein to bring about normal blood-regeneration (Damodaran and Vijayaraghavan, *loc. cit.*). The P.A. factor was given orally in the form of Cohn's Fraction G (Cohn, Minot and Murphy, 1927[8]). Starting from the fourth day after injection of phenylhydrazine, when the anæmia reaches its peak, 1 ml. of the extract was fed to each animal daily. Aqueous solutions containing 5 per cent., 2·5 per cent., and 1·25 per cent. of Fraction G were tried on three different groups of animals. The control group received no liver extract.

Table I which gives the average values of

TABLE I

Group	Number of animals	Average RBC millions/c.mm. 4th Day	12th Day	% Inc.	Excess over control	Average Hb gm./100 ml. 4th Day	12th Day	% Inc.	Excess over control
A 5% Liver Extract	6	3·89	7·56	94·4	42·3	8·86	13·62	53·7	−1·4
B 2·5% Liver Extract	6	3·46	6·03	74·3	22·2	8·40	13·31	58·4	3·3
C 1·25% Liver Extract	6	3·96	6·25	58·1	6·0	9·13	13·96	52·9	−2·2
Control	5	4·01	6·10	52·1	—	8·98	13·93	55·1	—

R.B.C. and hæmoglobin for the four groups of animals shows clearly that liver extract in suitable concentrations exercises a marked effect on the rate of red blood cell regeneration in phenylhydrazine anæmia. The results also indicate that in one important respect the hæmopoietic action of the liver extract differs from that of amino-acids and proteins previously reported. The action of liver extract lies solely in the increase of erythrocytes without a corresponding increase in the percentage of hæmoglobin. This is in conformity with the view that amino-acids and proteins provide the structural material for the formation of hæmoglobin while the action of the P.A. factor is on the hæmopoietic apparatus, *i.e.*, on the reticulo-endothelial system.

Although Cohn's Fraction G is not known to contain any hæmopoietically active substance other than the P.A. factor it would be rash to conclude from these experiments that the effects noted are due in fact to this factor. Wright and Arthur (*loc. cit.*) came to their negative conclusion quoted above in spite of finding that the anæmia induced by phenylhydrazine is much less acute in liver-fed rabbits than in control animals receiving no liver treatment. These authors were inclined to the view that the mitigating influence of liver extracts was not due to the P.A. factor but to the presence in it of some other substance which neutralised the destructive effect of phenylhydrazine on blood corpuscles. Although their experimental data hardly bear out this view there is no doubt that much further experimentation, accompanied by clinical trials, will be necessary before the regeneration of erythrocytes in phenylhydrazine anæmia can be accepted as a suitable method for the assay of the P.A. factor.

University Biochemical Laboratory, Madras,
August 9, 1944.

M. DAMODARAN.
P. K. VIJAYARAGHAVAN.

1. Yeshoda, K. M., *Curr. Sci.*, 1942, **11**, 360. 2. Damodaran, M., and Vijayaraghavan, P. K., *Ibid.*, **1943**, **12**, 115. 3. Yeshoda, K. M., *Ibid.*, 1943, **12**, 326. 4. Paton, D. N., and Goodall, A., *J. of Physiol.*, 1903, **29**, 411. 5. Price-Jones, C., *J. of Path. and Bact.*, 1911, **16**, 48. 6. Erdos, J., *Biochem. Zeitsch.*, 1935, **277**, 342. 7. Wright, G. P., and Arthur, B., *J. of Path. and Bact.*, 1930, **33**, 1017. 8. Cohn, E. J., Minot, G. R., and Murphy, W. P., *J.B.C.*, 1927, **74**, 69.

DERIVATIVES OF 3-(p-METHOXYPHENYL)-*CYCLO*HEXANONE

THE following is a brief account of experiments of an exploratory nature which were made with the object of preparing 3-(*p*-methoxyphenyl)-*cyclo*hexanone required in connection with another research.

5-*p*-Methoxyphenyldihydroresorcinol[1] when treated with phosphorus trichloride[2] readily yields 5-chloro-3-(*p*-methoxyphenyl)-Δ^5-*cyclo*hexenone, m.p. 70° which on reduction with sodium and moist ethereal solution, gives 3-(*p*-methoxy-phenyl)-*cyclo*hexanol, m.p. 83-84°. The latter on cautious oxidation with Beckmann's chromic acid mixture furnishes, 3-(*p*-methoxy-phenyl)-*cyclo*hexanone, b.p. 155°/4 mm. (semicarbazone, m.p. 194°). The same ketone can also be made directly by the reduction of 5-chloro-3-(*p*-methoxyphenyl)-Δ^5-*cyclo*hexenone by means of hydrogen in presence of colloidal palladium.[3]

The unstable δ-lactonic ester[4] derived from ethyl γ-anisoylbutyrate, zinc and ethyl bromoacetate on hydrolysis with 10 per cent. alcoholic potash furnishes an unsaturated dicarboxylic acid, $C_{14}H_{16}O_5$, m.p. 153-154°. The corresponding diethyl ester, b.p. 189-192°/4 mm. readily absorbs one equivalent of hydrogen in presence of Adams platinum catalyst giving ethyl β-(*p*-methoxyphenyl)-pimelate, b.p. 190°/5 mm. This on hydrolysis affords β-(*p*-methoxyphenyl)-pimelic acid, m.p. 92-93°. The latter on ketonisation with acetic anhydride smoothly furnishes 3-(*p*-methoxyphenyl)-*cyclo*hexanone, described above, identified by its b.p. 148-150°/5 mm., and semicarbazone, m.p. 194°. The unsaturated acid, m.p. 153-154°, under precisely similar conditions affords 3-(*p*-methoxyphenyl)-Δ^2-*cyclo*hexenone, m.p. 84°, semicarbazone, m.p. 217-219°, evidently identical with the ketone represented by Banerjee[4] as 3-(*p*-methoxyphenyl)-*cyclo*hexanone.

Finally, the unsaturated ketone, m.p. 84°, described above, was synthesised by the action of ω-chloro-*p*-methoxypropiophenone[5] on ethyl sodio-acetoacetate followed by alkaline hydrolysis of the resulting product, which leaves no further room for doubt regarding the structure assigned to this compound.

It follows, therefore, that Banerjee's ketone, m.p. 83°, must be correctly represented as 3-(*p*-methoxyphenyl)-Δ^2-*cyclo*hexenone, although the analytical results actually found for the ketone by Banerjee are in excellent accord with those calculated for 3-(*p*-methoxyphenyl)-*cyclo*hexanone.

My best thanks are due to Dr. J. C. Bardhan for his kind interest in the work.

University College of Science and Technology, Calcutta,
July 21, 1944.

PIYUSKANTI CHAUDHURI.

1. Vorlander, *Annalen* 1897, **294**, 310; Hinkel, Ayling and Dippy, *J. Chem. Soc.*, 1935, 540; Friedmann, *J. Pr. Chem.*, 1936, **146**, 65. 2. Crossley, *J. Chem. Soc.*, 1911, **1108**; Byod, Clifford, Probert, *Ibid.*, 1920, 1388. 3. France, Heilbron and Hey, *J. Chem. Soc.*, 1940, 1290; Skita and Franck, *Ber.*, 1911, **44**, 2862. 4. Banerjee, *J., Indian Chem. Soc.*, 1940, **17**, 576. 5. Kenner and Statham, *J. Chem. Soc.*, 1935, 301.

SYNTHESES OF 1-NAPHTHALENE-SUBSTITUTED ISOQUINOLINES

IN connection with a scheme for study of isoquinoline bases containing the naphthalene ring which may prove physiologically active it became necessary to investigate the synthesis of substances containing naphthyl residues in the 1-position of the isoquinoline molecule. The latter had in common homopiperonylamine as the starting material. The necessary intermediate N-acyl homopiperonylamides were

obtained in excellent yields by the interaction of molecular proportions of homopiperonylamine and the respective acid chlorides in the presence of dil. NaOH. The amides now prepared are *α-naphthoyl homopiperonyl amide*, m.p. 130-31°, *β-naphthoyl homopiperonyl amide*, m.p. 140-41° and *α-naphthylacetyl homopiperonyl amide*, m.p. 129-31°. These separated from alcohol in colourless needles. On being subjected to the dehydrating action of $POCl_3$ in toluene, α- and β-naphthoyl homopiperonyl amides underwent the classical Bischler-Napieralsky reaction[1] and furnished in satisfactory yields the corresponding 1-naphthyl dihydro isoquinolines: 1, *α-naphthyl, 3:4-dihydro, 6-7-methelenedioxy isoquinoline* separated from petroleum ether in colourless needles, m.p. 109-10° (*Picrate*, orange yellow needles from alcohol, m.p. 164-65°; *Picrolonate*, yellow needles from alcohol-acetic acid, m.p. 228-31° dec.); 1, *β-naphthyl 3:4-dihydro, 6:7-methylenedioxy isoquinoline* separated from alcohol in colourless, prismatic needles, m.p. 140-41° (*Picrate*, yellow needles from alcohol-acetic acid, m.p. 191-92°. *Picrolonate*, yellow needlettes from alcohol, m.p. 189-93° dec.). On the other hand, cyclodehydration of α-naphthylacetyl homopiperonyl amide through the agency of $POCl_3$ in boiling toluene was by no means smooth. The main product of the reaction was a neutral, chlorinated compound, m.p. 258-59° dec. At the same time a basic substance, presumably the desired 1, *α-naphthyl methyl, 3:4-dihydro, 6:7-methylenedioxy isoquinoline*, was also formed in poor yields. Furthermore, the aforementioned base and even its hydrochloride in solution were characteristically unstable, a property which may be ascribed to the presence of the reactive methylene group linking the isoquinoline and naphthalene nuclei. Nevertheless, it has been possible to characterise the 1, *α-naphthylmethyl*, 3:4-dihydro, 6:7-methylenedioxy isoquinoline as its *picrate* separating from alcohol-acetic acid in orange yellow crystals, m.p. 166-68° dec.

The customary procedure of heating with zinc and dil. sulphuric acid was inapplicable to the reduction of 1, α-naphthyl, 3:4-dihydro, 6:7-methylenedioxy isoquinoline to the corresponding tetrahydro derivative, since it led to the formation exclusively of a neutral, metal-free compound separating from alcohol in colourless needles, m.p. 252-54° dec. The attempt to reduce 1, β-naphthyl, 3:4-dihydro, 6:7-methylenedioxy isoquinoline by means of zinc and dil. sulphuric acid likewise did not meet with success but gave rise to a nonbasic, metal-free product separating from alcohol in colourless needles, m.p. 241-43° dec. An insight into the nature of the two neutral substances as also that of the chloro compound encountered in the cyclisation of α-naphthylacetyl homopiperonyl amide has not yet been gained.

It is hoped to investigate in detail the cyclisation if α-naphthylacetyl homopiperonyl amide and the reduction of the isomeric 1-naphthyl, 3:4-dihydro, 6:7-methylenedioxy isoquinolines to the respective tetrahydro-bases changing, necessarily, the experimental conditions. The results of these studies under way will form the subject of a further communication.

Presidency College,
Madras,
July 26, 1944.

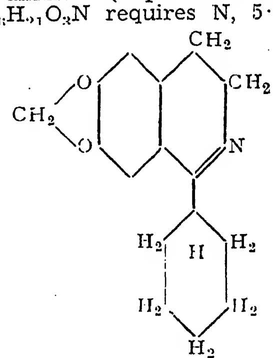
B. B. Dey.
S. Rajagopalan.

1. Bischler and Napieralsky, *Ber.*, 1893, **26**, 1903. Pictet *et al.*, *Ibid.*, **1909**, **42**, 1973, 1979; Decker *et al.*, *Ibid.*, 1909, **42**, 2075; *Ann.*, **1913**, **395**, 299.

1-CYCLOHEXYL NORHYDRASTININE AND DERIVATIVES

In a previous communication,[1] it was stated that the reduction of 1-benzyl, 1-cyclohexyl and 1-cyclohexyl methyl norhydrastinines with aluminium amalgam would be studied. Due to certain difficulties this has not been possible, but 1-cyclohexyl norhydrastinine and its derivatives prepared for purposes of this work have not been described in literature and are, therefore, reported here.

Cyclohexyl-3, 4 methylenedioxy phenyl ethyl amide was prepared by the action of cyclohexane carboxylic acid chloride on homopiperonyl amine (m.p. 135-36°; Found: N, 5·1; $C_{16}H_{21}O_3N$ requires N, 5·8 per cent.)



(I)

The amide was converted by phosphorous oxychloride in boiling toluene to *1-cyclohexyl norhydrastinine* (I). (Prisms from methanol or clusters of interlacing rhombic needles from ligroin, m.p. 82°. Found: N, 5·6; $C_{16}H_{19}O_2N$ requires N, 5·5 per cent.; Picrate, crystallised from glacial acetic acid in rectangular blocks, m.p. 221°; Methiodide, m.p. 222-24°).

On reduction with zinc and sulphuric acid, the dihydro isoquinoline (I) gave in good yield 1-*cyclohexyl norhydrohydrastine* (Twig-shaped clusters of rhombic needles on slow crystallisation from petroleum ether, m.p. 47°; Picrate, crystallised from dilute alcohol, m.p. 206°; Hydrochloride sparingly soluble, hexagonal blocks, m.p. 244°; Hydrobromide, m.p. 237°; the nitroso derivative was formed at 0°, but decomposed instantaneously at room temperature).

Presidency College,
Madras,
August 3, 1944.

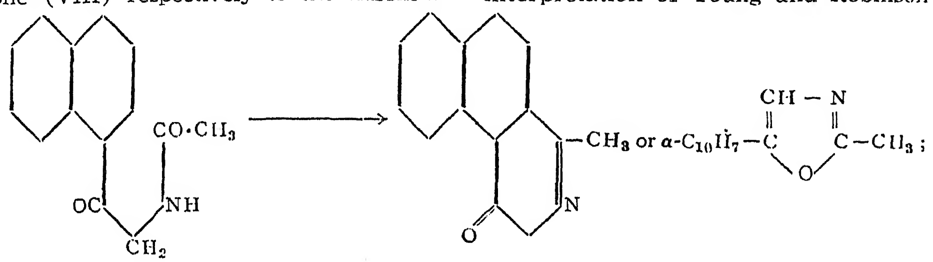
B. B. Dey.
T. R. Govindachari.

1. Dey and Govindachari, *Proc. Nat. Inst. Sci.*, 1940, **6**, 219.

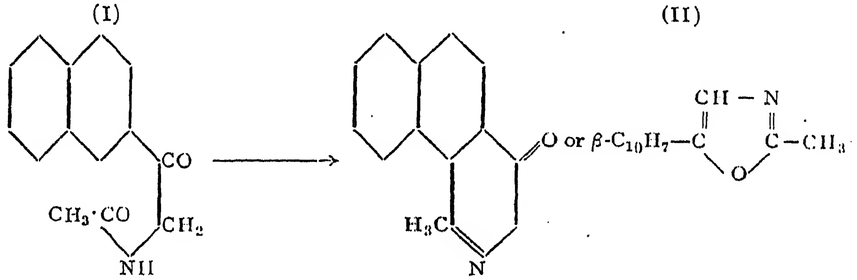
OXAZOLES DERIVED FROM THE NAPHTHALENE RING

Some years ago we reported[1] the synthesis of 1-methyl, 3:4-dihydro, 4-keto, 5:6-benzoisoquinoline (II), 1-methyl, 3:4-dihydro, 4-keto, 7:8-benzoisoquinoline (IV), 1-methyl, 3:4-dihydro, 4-keto, 7-methoxy, 5:6-benzoisoquinoline (VI) and 1-phenyl, 3:4-dihydro, 4-keto, 7-methoxy, 5:6-benzoisoquinoline (VIII) by subjecting N-acetyl, ω-amino, α-acetonaphthone (I), N-acetyl, ω-amino, β-acetonaphthone (III), 4-methoxy, N-acetyl, ω-amino acetonaphthone (V) and 4-methoxy, N-benzoyl, ω-amino acetonaphthone (VIII) respectively to the Bischler-Napieralsky reaction[2] of heating with phosphoryl chloride in toluene.

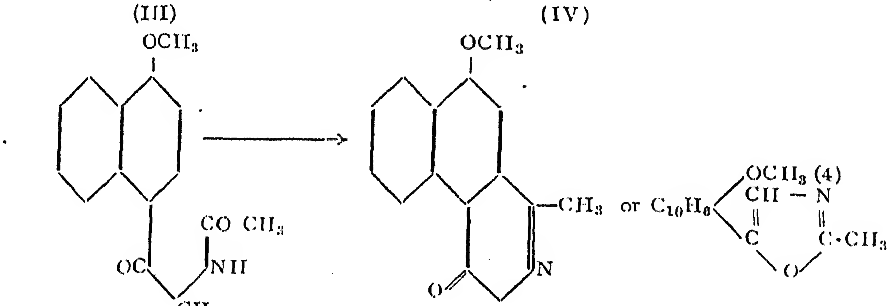
The assumption of the structures of the feebly basic substances, II, IV, VI and VIII, resulting from the dehydration of the amides, I, III, V and VII, was based by analogy on the report of Buck[3] that homoveratroyl ω-amino acetoveratrone gave rise, under similar conditions to a 4-keto isoquinoline derivative. However, the report of Buck has subsequently been critically examined by Young and Robinson[4] who showed that the supposed isoquinolone was in reality 2-homoveratryl, 5-veratryl oxazole; the correctness of the interpretation of Young and Robinson concern-



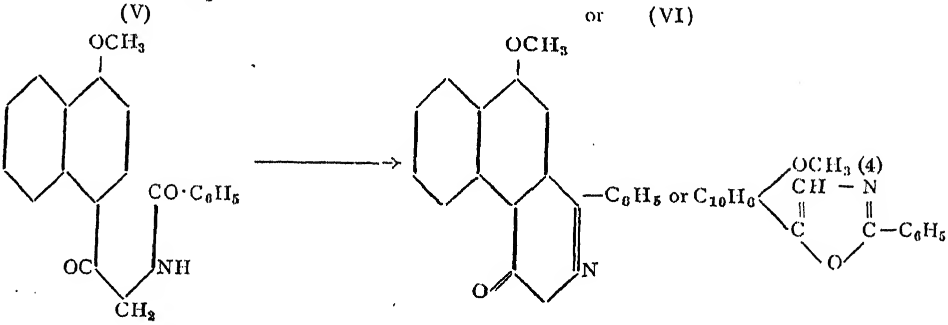
(I) (II)



(III) (IV)



(V) or (VI)



(VII) (VIII)

ing the mechanism of the reaction involved has been further acknowledged by Buck.[5]

The only instance of the preparation of oxazoles linked to the naphthalene ring recorded in literature is that regarding the synthesis of 2, α-naphthyl, 5-phenyl oxazole and 2-phenyl, 5-α-naphthyl oxazole by Lister and Robinson[6] who obtained them by the action of conc. H_2SO_4 on α-naphthoyl, ω-amino acetoveratrone and N-benzol, ω-amino, α-acetonaphthone respectively. The two naphthyl oxazole derivatives were feeble bases and exhibited fluorescence more intense than those of other oxazoles in solutions, a property which was supposed to be dependent on the long uninterrupted chains of conjugate double linkages connecting the aromatic nuclei through the oxazole ring.[6,7]

We have carefully repeated the preparation of 2-phenyl 5-α-naphthyl oxazole using concentrated sulphuric acid as directed by Lister and Robinson as well as phosphorous oxychloride both with and without the addition of toluene as the cyclising agents. Although according to Lister and Robinson the cyclising agent of choice in the synthesis of 2-naphthyl, 5-phenyl oxazole is conc. H_2SO_4, the cyclisation of N-benzil, ω-amino, α-acetonaphthone is best effected by employment of phosphoryl chloride. We have also studied the action of conc. H_2SO_4 on the amides III, V and VII. A solution of III in five parts of conc. H_2SO_4, after heating at 100° for 5 minutes and dilution with ice-water gave in addition to resinous matter only a trace of basic matter which could not be characterised. The action of H_2SO_4 on the amides V and VII at room temperature was nil, the original amides being completely recoverable at the conclusion of the experiments. However, the action of sulphuric acid at 100° for 5 minutes on VII gave rise to a pale yellow solid separating from alcohol-acetic acid as a pale yellow crystalline powder exhibiting violet fluorescence in alcoholic or sulphuric acid solution and melting at 308-09° dec. The same product is also obtainable from VIII by similar action of H_2SO_4. The substance appears to be acidic in character and has not yet been fully investigated.

Although it is usual to consider oxazoles as capable of breaking down to acids and amides on evaporation with hydrochloric acid and that oxidants and reducing agents frequently rupture the oxazole ring with great ease,[8] the oxazoles derived from naphthalene should be considered as fairly stable. We had formerly reported[1] that oxidising agents such as alkaline hydrogen peroxide, dilute nitric acid and potassium permanganate in acetone solution had no action on the base VIII and that all the substances (II, IV, VI and VIII) then synthesised were resistant to reduction by the usual chemical methods. Some of the reducing agents used were zinc dust and sulphuric acid, amalgamated zinc and hydrochloric acid and tin and hydrochloric acid. The action of a few mineral acids on the above bodies has now been studied. The base IV by heating with con. HCl at 150-60° for 4 hours gave rise to intractable tarry matter, while simple refluxion with a mixture of acetic and hydrobromic acids for 5 hours resulted only in the recovery of IV. The action of acetic acid-hydrobromic acid on VIII yielded an acidic principle, separating from alcohol in pale yellow needles, m.p. 193-95° after softening at 191° and exhibiting violet fluorescence in alcoholic solution. Hydrobromic acid had no action whatsoever on 2-phenyl, 5-α naphthyl oxazole.

Although conclusive evidence by degradation studies is as yet unavailable, there can be no doubt that from their method of formation and properties of feeble basicity and intense violet fluorescence in neutral organic solvents,[4,6,7,9,10] the substances hitherto considered to be benzoisoquinolones possess in reality the naphthalenic oxazole structures. The names of the compounds II, IV, VI and VIII, *viz.*, 1-methyl, 3:4-dihydro, 4-keto, 5:6-1-methyl,, 3:4-dihydro, 4-keto, 7:8-, 1-methyl, 3:4-dihydro, 4-keto, 7-methoxy, 5:6- and 1-phenyl, 3:4- dihydro, 4-keto, 7-methoxy, 5:6-benzoiscquinolines, therefore, should be corrected as 2-methyl, 5-α, naphthyl-, 2-methyl, 5-β, naphthyl-, 2-methyl, 5-(4', methoxy), naphthyl- and 2-phenyl, 5-(4', methoxy-) naphthyl oxazoles respectively.

Presidency College,
Madras,
July 26, 1944.

B. B. Dey.
S. Rajagopalan.

1. Dey and Rajagopalan, *Arch. Pharm.*, 1939, **217**, 359; *Proc. Nat. Inst. Sci. India*, 1940, **6**, 135. 2. Bischler and Napieralsky, *Ber.*, 1893, **26**, 1903. 3. Buck, *J.A.C.S.*, 1930, **52**, 3610. 4. Young and Robinson, *J.C.S.*, 1933, 275. 5. Buck, *Ibid.*, 1933, 740. 6. Lister and Robinson, *Ibid.*, 1912, **101**, 1297. 7. Robinson, *Ibid.*, 1909, **95**, 2167. 8. Richter's *Organic Chemistry*, 1923, **3**, 113. 9. Foulds and Robinson, *J.C.S.*, 1913, **103**, 1768. 10. Gabriel, *Ber.*, 1910, **43**, 143, 1283.

N[1]-SULPHANILYL-ISOTHIOUREAS

In continuation of the work already reported,[1] the following compounds of the general formula (I) have been made:—

$Ac{\cdot}NH{\cdot}C_6H_4{-}SO_2{-}NH{-}C(:NH){\cdot}SR$ (I)

1. $R = CH_2{\cdot}CH_2{\cdot}CH(CH_3)_2$; m.p. 186°:
2. The free base, m.p. 145-46°
3. $R = CH_2{\cdot}C_6H_5$; m.p. 173°
4. The free base, m.p. 143-46°
5. $R = CH_2{\cdot}C_6H_4{\cdot}NO_2(p)$; m.p. 214-25°
6. The free base, m.p. 153-55°
7. $R = CH_2{\cdot}C_6H_4{\cdot}OCH_3$; m.p. 138-40°
8. The free base, m.p. 89-92°
9. $Ac{\cdot}NH{\cdot}C_6H_4{\cdot}SO_2{\cdot}NH{\cdot}C(:NH)S{\cdot}CH_2$ | $Ac{\cdot}NH{\cdot}C_6H_4{\cdot}SO_2{\cdot}NH{\cdot}C(:NH)S{\cdot}CH_2$; m.p. 255°
10. The free base ; m.p. 175-77°

The compound No. 1 was hydrolysed with 10 per cent. aqueous HCl, to get the corresponding free base No. 2, and compounds Nos. 3, 5, 7 and 9 were hydrolysed with alcoholic HCl to get the corresponding free bases.

The following sulphanilamide derivatives of N-aryl substituted pseudo-thioureas of the general formula (II) have been made:—

$Ac\,NH \cdot C_6H_4\text{–}SO_2\text{–}N\ R'\text{–}C(:NH) \cdot SR''$ (II)

1. R′ = Phenyl ; R″ = Ethyl ; m.p 209–10°
2. The free base ; m.p. 192–93°
3. R′ = Phenyl ; R″ = Propyl ; m.p. 206–7°
4. The free base ; m.p. 195–96°
5. R′ = Phenyl ; R″ = Butyl ; m.p. 207–8°
6. The free base ; m.p. 191–92°
7. R′ = Phenyl ; R″ = Allyl ; m.p. 204°
8. The free base ; m.p. 193–94°
9. R′ = Phenyl ; R″ = Benzyl ; m.p. 205–6°
10. The free base ; m.p. 190°
11. R′ = Phenyl ; R″ = p-nitro-benzyl ; m.p. 201°
12. The free base ; m.p. 166° (decomp.)
13. R′ = p-tolyl ; R″ = Ethyl ; m.p. 204–6°
14. The free base ; m.p. 188–89°
15. R′ = p-methoxy-phenyl ; R″ = ethyl ; m.p. 200–1°
16. The free base ; m.p. 194°
17. R′ = β-naphthyl ; R″ = ethyl ; m.p. 201–2°
18. The free base ; m.p. 186–88°

These compounds await pharmacological examination.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
August 9, 1944.

P. C. Guha.
V. Mahadevan

1. *Curr. Sci.*, 1943, **12**, 325.

SYNTHESIS OF SULPHANILAMIDE COMPOUNDS CONTAINING ALKYL-THIOL-1-SUBSTITUTED THIOSEMICARBAZIDES

In a previous communication[1] sulphanilamide compounds with thiosemicarbazide, and 4-phenyl-thiosemicarbazide have been described. Due to the pronounced basic character of the hydrazino group ($-NH.NH_2$) in all these cases acetamino benzene suphonylchloride reacted with the nitrogen in position 1. It seemed to be interesting to prepare sulphanilamido derivatives of 1-N-aryl thiosemicarbazides. There being no basic group like ($.NH.NH_2$) present in 1-substituted aryl-thiosemicarbazides they did not react with the sulphochloride. But 1-N-aryl-thiosemicarbazides reacted readily with alkyl halides to give the corresponding alkyl-thiol derivatives which reacted readily with acetaminophenylsulphochloride to give the compounds of the general formula (I) or (II).

$$Ac \cdot NH \cdot C_6H_4 \cdot SO_2 \cdot N = \underset{\displaystyle SR}{\underset{|}{C}}\text{–}NH \cdot NH \cdot Ph \qquad \text{(I)}$$

$$Ac \cdot NH \cdot C_6H_4\text{–}SO_2 \cdot \underset{\displaystyle NHPh}{\underset{|}{N}}\text{———}\underset{\displaystyle SR}{\underset{|}{C}}:NH \qquad \text{(II)}$$

1. R = Ethyl ; m.p. 104–7°
2. R = Propyl ; m.p. 91°
3. R = Butyl ; m.p. 110°
4. R = Allyl ; m.p. 83–6°
5. R = Benzyl ; m.p. 62–7°
6. R = p-nitrobenzyl ; m.p. 125°

Further work is in progress to elucidate as to whether the sulphanilamide compounds possess the structure (I) or (II).

The pharmacological studies of these compounds are in progress.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
August 9, 1944.

P. C. Guha.
V. Mahadevan

1. *Curr. Sci.*, 1943, **12**, 150.

STUDIES ON ANÆSTHETICS AND LOCAL ANÆSTHETICS

N-Substituted Amides and Esters of Nicotinic, Picolinic, and *Iso*-Nicotinic Acids

Of the three isomeric pyridine monocarboxylic acids, the β-variety, *viz.*, nicotinic acid has, in recent years, assumed great importance as an accessory food factor belonging to the vitamin B complex[1] with great therapeutic possibilities. Further its diethylamide, familiarly known as 'Coramine', is a reputed cardio-respiratory stimulant.[2] A further point of interest in this acid is that its N-substitued ethanolamine and homologous esters have been shown to possess local anæsthetic activity.[3]

The present work, therefore, involves the preparation of the three isomeric acids from β- and γ-picolines isolated from the middle oil fraction of Indian coal-tar, and the α-acid from a sample of α-picoline. The β-acid was also prepared by the decarboxylation of quinolinic acid obtained by the oxidation of qinoline (*i*) isolated from Indian coal-tar, and (*ii*) synthesised by Scraup's method.

Though there is considerable literature on the oxidation of the picolines and quinoline, the available information was found to be very inadequate, and the detailed conditions for their convenient preparation had to be worked out using $KMnO_4$ solution at temperatures below 100° C., and isolation of the acids through the copper salts. Results of our experiments are given below:—

Raw material used	Acid obtained	Yield (% on theory)	M.P.	Equivalent
1. α–Picoline B.P. 124–29°	Picolinic acid	25	135–136°	123·4
2. Mixture of β & γ–picoline B.P. 140–47°	*Nicotinic acid	11	225–226°	125·5
	*Isonicotinic acid	12·5	305–306°	122·1
3. Quinoline B.P. 230–35°	Quinolinic acid	33	180° (decomp.	83·9
4. Quinolinic acid	Nicotinic acid	80	232°	122·2

* Separated from the oxidation product by repeated crystallisation from absolute alcohol.

Coramine (b.p. 172–173°/19 mm.) has been prepared (yield, 68·8 per cent.) from nicotinic acid, *via.* its acid chloride, by the action of diethylamine also prepared in this laboratory.

From the acid chloride of the above pure mono acids, the following *new* N-substituted amides, which are likely to possess anæsthetic action, have been prepared.

(1) Picolinic acid *p*-anisidide, m.p. 88°;
(2) Picolinic acid *o*-anisidide, m.p. 110°;
(3) Nicotinic acid *p*-anisidide, m.p. 141°;
(4) Isonicotinic acid *p*-anisidide, m.p. 153°;
(5) Picolinic acid benzyl amide (semi-solid).

β-Chlorethyl picolinate, C_5H_4N-CO_2-$CH_2.CH_2.Cl$ (b.p. 136-138°/5-7 mm.) and β-chlorethyl nicotinate (b.p. 167-69°/45 mm.), have been prepared from the corresponding acid chlorides by the action of ethylene chlorhydrin. *p*-Methoxyphenylaminoethyl picolinate, C_5H_4N-$COO.CH_2.CH_2.NHC_6H_4.OCH_3$, was prepared from the chlorethyl ester by the action of *p*-anisidine; acetyl derivative, m.p. 170°. Further work on the preparation of some typical esters and amides of this series is in progress. The compounds prepared await pharmacological examination.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
August 9, 1944.

P. C. Guha.
R. Krishna Maller.

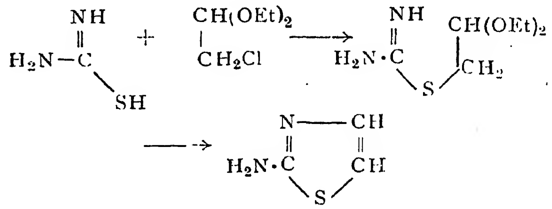
1. *Indian Med. Gaz.*, 1942, **77,** 98. 2. *J. Amer. Pharm. Assoc.*, 1944, **33,** 72. 3. *J. Amer. Chem. Soc.* 1942, **64,** 1721.

N[1] AND N[4] SUBSTITUTED SULPHANILAMIDES

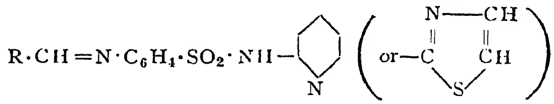
Part I. Schiff's Base of Sulpha-pyridine and Sulpha-thiazole

Although a number of Schiff's bases of sulphanilamide have been prepared and they have shown to be therapeutically active, no systematic investigation seems to have been undertaken on the preparation of Schiff's bases of the two well-reputed sulphanilamide drugs, *viz.*, of sulpha-pyridine and sulpha-thiazole. The three anils of sulpha-pyridine[1] known so far have been prepared by the action of benzaldehyde, *p*-methoxy-benzaldehyde and cinnamic aldehyde, and they have been found to possess good therapeutic properties. No anil (Schiff's base) seem to have been prepared from sulpha-thiazole.

Aminothiazole to be used for the preparation of sulphathiazole required as the starting material for our work was prepared by the action of chloracetal (prepared in this laboratory in satisfactory yield[2]) on thiourea. The method (English patent, E.P. 540,032, by the British Drug House, Ltd., by the action of brominated alcohol on thiourea; and the Indian Patent, 29,345, by the Director, Haffkine Institute, Bombay) by the action of chlorinated alcohol (in none of which details are given) came to our notice after the new method of preparation of aminothiazole was established in this laboratory. The reaction proceeds as follows:—



The following anils of sulpha-pyridine and sulpha-thiazole have been prepared:—



R	Melting point of anils of sulphapyridine	M.P. of anils of sulpha-thiazole
C_6H_5	240°	202°
p-$OCH_3 \cdot C_6H_4$	205°	160°
3-OH, 4-$OCH_3 \cdot C_6H_3$	146–47°	245°
3, 4, $(OCH_3)_2 \cdot C_6H_3$	210°	138°
$C_6H_5 \cdot CH=CH$	210°	260°
C_4H_3O (furfuraldehyde)	214°	chars at 210°
m-$NO_2 \cdot C_6H_4$	254°	231°
m-$Cl \cdot C_6H_4$	101°	124°
$C_6H_5 \cdot CH_2$	decomposes at 100°	164°

Fuller details will be published elsewhere. These compounds await pharmacological examination.

Work on the preparation of some more anils as also some acyl and sulphanyl derivatives, is in progress.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
August 9, 1944.

P. C. Guha.
K. R. Doraswami.

1. Kalloff, H. G., and Hunter, J. H., *J. Amer. Chem. Soc.*, 1940, **62,** 158. 2. vide *Curr Sci.*, 1943, **12,** 82.

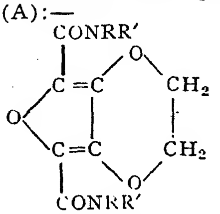
STUDIES ON ANÆSTHETICS AND LOCAL ANÆSTHETICS

Amides and Esters of 2:5-Dicarboxy-furo-(3:4)-*p*-dioxan

Gilman[1] observed that β-diethylamino ethyl esters of acids containing aminobenzene, benzene, pyrrole, thiophene and furan rings possess low local anæsthetic action. Cook and Kreke,[2] from a comparison of the local anæsthetic actions as exhibited by the diethylamino ethyl esters of benzoic and furoic acids, showed that furoates are frequently somewhat superior. Degnan and Pope[3] prepared large number of N-alkyl N-aryl furaminines, and made the interesting observation that N-*n*-butyl N′-*p*-phenetylfuramidine hydrochloride is more than three times as active as cocaine, and it is not

irritating to the cornea of the eye. It seemed very reasonable, therefore, that a search for new and efficient local anæsthetics in the differently (alkyl and aryl) substituted esters, amides and amidines might lead to some very interesting results.

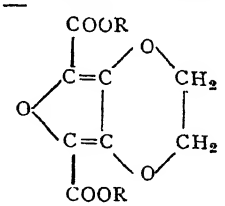
2:5-Dicarboxy-furo-(3:4)-*p*-dioxan has been prepared starting from diglycollic acid by five steps.[4] This di-acid gave the acidchloride, m.p. 154°; yield 80 per cent. The di-acid chloride by reacting with varieties of aliphatic and aromatic amines have given the following diamides (A):—



(A)

(1) R = H; R′ = H; m.p 333–35°
(2) R = H; R′ = Me; m.p. 260°
(3) R = Et, R = Et; m.p. 102°
(4) R = H; R′ = Ph; m.p. 103°
(5) R = H; R′ = *p*-methoxy-phenyl; m.p. 226°
(6) R = H; R′ = *o*-methoxy-phenyl; m.p. 339°
(7) R = H; R′ = o-tolyl; m.p. 322°
(8) R = H; R′ = *p*-tolyl; m.p. 257°
(9) R = H; R′ = *m*-tolyl; m.p. 271°
(10) R = H; R′ = benzyl; m.p. 86°
(11) R = H; R′ = $C_6H_4 \cdot SO_2NH$; 270° (decomp.)

The following four diesters (B) have been prepared:—



(B)

(1) R = benzyl; m.p. 126°
(2) R = $CH_2 \cdot CH_2 \cdot N(C_2H_5)_2$; m.p. 271°
(3) R = $CH_2 - CH = CH \cdot C_6H_5$; m.p. 169-71°
(4) Ethyl-thio-ester, m.p. 182°

Further work on the preparation of some more esters, amides and amidines of this series, as also on the preparation of esters, amides and amidines with the diacid chlorides of 2:5-dicarboxythieno-(3:4)-*p*-dioxan, and pyrro-(3:4)-dioxans is in progress.

The above compounds are under pharmacological examination.

Organic Chemistry Laboratories,
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
August 9, 1944.

P. C. GUHA.
A. H. MEHTA.

1. *J. Amer. Chem. Soc.*, 1925, **47**, 245. 2. *Ibid.*, 1940, **62**, 1951. 3. *Ibid.*, 1940, **62**, 1960. 4. *J. Indian Inst. Sci.*, 1938, **21A**, 115.

CHEMICAL NON-HOMOGENEITY IN CHROMITES AND ITS POSSIBLE USEFULNESS IN INDUSTRY

IN the course of my investigations on the conversion of the Cr_2O_3 of chromite to chromate, I found that, in almost all experiments, the undecomposed portion of the chromite had a higher value for the ratio Cr/Fe than the chromite as a whole. This indicated that the chromite might not be chemically homogeneous and, to test this point, two samples of chrome ore were systematically investigated.

The ores had to be repeatedly fused with Na_2CO_3 and dissolved in sulphuric acid before they could be brought into complete solution. Eight such fusions were necessary in the case of one sample and seven in the case of the other. Even then small residues were left, which were rejected. The ores and the successive residues were mixed with their own weight of Na_2CO_3 and heated in a platinum crucible, kept slanting, with the lid on the crucible leaving a small opening, over the full flame of a Bunsen burner for two hours. I have repeatedly found that Na_2CO_3 fusion of chrome ore does not bring about complete solution of the ore at the first fusion or even after three or four fusions although strong heat is applied for a longer period. But this necessity for repeated fusion was an advantage in this investigation. The solution obtained after each fusion was separately analysed.

In Table I are given the percentages of Cr_2O_3 and Fe actually obtained, the percentage of Cr_2O_3 calculated as the percentage of the total Cr_2O_3 and the value of the Cr/Fe ratio for each solution. The samples are numbered 1764 and 1926. Total Cr_2O_3 per cent., total Fe per cent. and the value of the ratio Cr/Fe are respectively 49·60, 15·48 and 2·192 for 1764 and 48·29, 13·88 and 2·38 for 1926.

All the solutions of sample 1926 and only the last four solutions of 1764 were analysed for Al_2O_3 and MgO also, besides Cr_2O_3 and Fe. To make out the non-homogeneity more clearly, the sum of the compositions of solutions 2, 3 and 4, of 5, 6 and 7, and of all the six solutions of 1926, expressed in terms of the four molecules, $MgO.Al_2O_3$, $MgO.Cr_2O_3$, FeO, Cr_2O_3 and $FeO.Fe_2O_3$, and calculated to 100, are given in the bottom of Table II under columns 4, 5 and 6 respectively. The actual compositions in terms of the constituents Cr_2O_3, Al_2O_3, Fe_2O_3, Fe and MgO are also given in the top of the table. The composition of the first solution was not taken for calculation as it contained all the magnesium silicate mixed in the ore. In the case of 1764 the pure chromite mineral present in it was 80 per cent. of the ore. The mixed magnesium silicate was freed from it by heating with a mixture of HF and H_2SO_4 acids in which it dissolved. The percentages of Cr_2O_3, Al_2O_3, Fe and MgO present in this 80 per cent. of mineral were determined. The compositions of this, of the the sum of the four solutions 5, 6, 7 and 8, and of the difference between these two are expressed and calculated in the same way as for 1926 and given in the bottom of Table II under

TABLE I

Solutions	1st	2nd	3rd	4th	5th	6th	7th	8th
of 1764								
1. Cr_2O_3 %	9·05	9·83	3·94	6·63	6·15	5·25	4·58	2·70
2. Fe %	6·55	3·31	1·27	1·46	1·08	0·82	0·68	0·36
3. Cr_2O_3 % calculated as above	18·25	19·82	7·94	13·37	12·40	10·58	9·23	5·44
4. Cr/Fe value	0·945	2·031	2·127	3·116	3·896	4·367	4·602	5·081
of 1926								
1. Cr_2O_3 %	11·20	9·40	5·15	5·96	6·09	3·56	6·64	
2. Fe %	5·01	3·51	1·34	1·29	1·11	0·59	1·08	
3. Cr_2O_3 % calculated as above	23·19	19·46	10·67	12·31	12·61	7·37	13·75	
4. Cr/Fe value	1·529	1·832	2·566	3·154	3·768	4·110	4·221	

TABLE II

Samples	1764			1926		
Columns	1	2	3	4	5	6
Composition of solutions of Table I	Composition of Col. 3 that of Col. 2	Solution Nos. 5, 6, 7 and 8	Composition in the mineral = 80% of ore	Solution Nos. 2, 3 and 4	Solution Nos. 5, 6 and 7	Solution Nos. 2, 3, 4, 5, 6 and 7
In terms of the Constituents	%	%	%	%	%	%
Cr_2O_3	29·49	18·68	48·17	20·51	16·29	36·80
Al_2O_3	3·17	1·09	4·26	5·53	4·14	9·67
Fe_2O_3	3·25	2·89	6·14	3·01	2·37	5·37
FeO	12·65	1·19	13·84	5·19	1·43	6·62
MgO	2·80	5·44	8·24	5·47	5·75	11·22
Total (= % of ore)	51·36	29·29	80·65	39·71	29·98	69·68
Cr/Fe Value	1·667	4·347	2·192	2·272	4·014	2·815
In terms of molecules and calculated to 100						
MgO · Al_2O_3	8·61	5·19	7·42	19·41	19·25	19·35
MgO · Cr_2O_3	14·39	80·72	39·12	39·51	65·50	50·69
FeO · Cr_2O_3	67·81	0·94	43·14	30·09	3·80	18·78
FeO · Fe_2O_3	9·19	13·17	11·12	10·98	11·44	11·18

columns 3, 2 and 1 respectively. The actual compositions are also given as for 1926. FeO and Fe_2O_3 were not determined directly. The total Fe was divided between FeO and Fe_2O_3 so as to make the molecular proportions of MgO + FeO equal to those of $Cr_2O_3 + Al_2O_3 + Fe_2O_3$.

It is seen clearly that there is great difference in composition among the three portions belonging to the same chromite mineral and this clearly points to its chemical non-homogeneity.

Mysore Geological Department,
Bangalore, M. R. ANANTANARAYANA IYER.
March 11, 1944.

A DISEASE OF THE EQUISETUM (*EQUISETUM DEBILE* ROXB.) DUE TO *FUSARIUM DIVERSISPORIUM* SHERB.

THE infected plants were collected from the canal bank at Harbanspura Rakh near Lahore by Mr. M. L. Seth. There is no reference to any disease of Equisetum plants in India, though quite a number of diseases of Equisetum and several due to *Fusarium* sp., have been reported from other countries. Amongst the pathogenic Fusaria growing on Equisetum may be mentioned *Fusarium equiseti, F. avenaceum* and *F. bulbigenum. Fusarium equiseti* (Cda.) Sacc. (= *F. falcatum* App. et. Wr.) has been reported by Banerji[1] as causing a leaf-spot disease of *Eichhornia crassipes.*

The infected plants were in a semi-wilted condition. The lower internodes developed whitish linear spots, about a millimetre in length. These spots when examined were found to contain numerous long septate *Fusarium* spores. Hyphæ collected below the epidermis. The spores germinated readily in hanging drops. Germ tubes are formed in 3-4 hours' time and are formed either from one or from both ends of the spores. These soon branch and become septate.

The fungus was first isolated by using acid media to keep down the bacteria. Later it was cultivated on potato glucose and Czapek's in

agar. In culture, the hyphæ grew deep into the medium and also produced plenty of aerial mycelium. The aerial mycelium is at first white but later becomes pinkish when conidia are developed in great numbers. The aerial mycelium produces flesh-coloured sporodochia, the spores being 1-5 (mostly 3-5) septate, sickle-shaped, not foot-celled, with papillate base and a gentle tapering, often slightly beaked, apex. The septa are fairly distinct, spore sizes are as follows:—

Three septa—
3.9×23.2 ($3.1 - 4.8 \times 18.1 - 30.1$) μ.
Length : Breadth ratio = 6 . 1.

Five septa—
4.3×35.8 ($3.6 - 4.8 \times 32.5 - 41.1$) μ.
Length : Breadth ratio = 8 : 1.

The spores lack the needle-shaped form of eupionnotes and also lack pionnotes. As the culture becomes old, its rose colour changes and it becomes yellowish as chlamydospores are formed. These are double-walled, and do not germinate immediately. They are 7-15 μ in diameter.

The fungus matches up well with *Fusarium diversisporium* Sherb. and the author is grateful to Dr. G. Watts Padwick, the Imperial Mycologist, for matching the species and for verification of the measurements of the spores.

The pathogenicity of the fungus has been established by inoculation experiments. Young plants growing in pots when sprayed with spore suspensions got readily infected.

Botany Department,
Panjab University,
Lahore, H. CHAUDHURI.
August 3, 1944.

1. *J. Dep. Sc. Cal. Univ.*, Vol. I, No. 3.

FASCIATED AERIAL ROOTS OF BANYAN (*FICUS BENGALENSIS* LIN.)

FASCIATION which results in the formation of a flattened structure due to the fusion of a number of like parts has often been observed in stems and floral axis of plants. An interesting example of fasciated inflorescence of *Acrocarpus fraxinifolius* Wight has been reported by Dr. N. L. Bhor.[1] Various causes have been ascribed for the occurrence of this abnormality but it has rarely, if ever, been reported in the case of roots of plants. For this reason the present instance of fasciation observed in the aerial roots of *Banyan* is of considerable interest.

An examination of the fasciated roots showed that they were formed by a fusion of more than one closely developing lateral roots. In

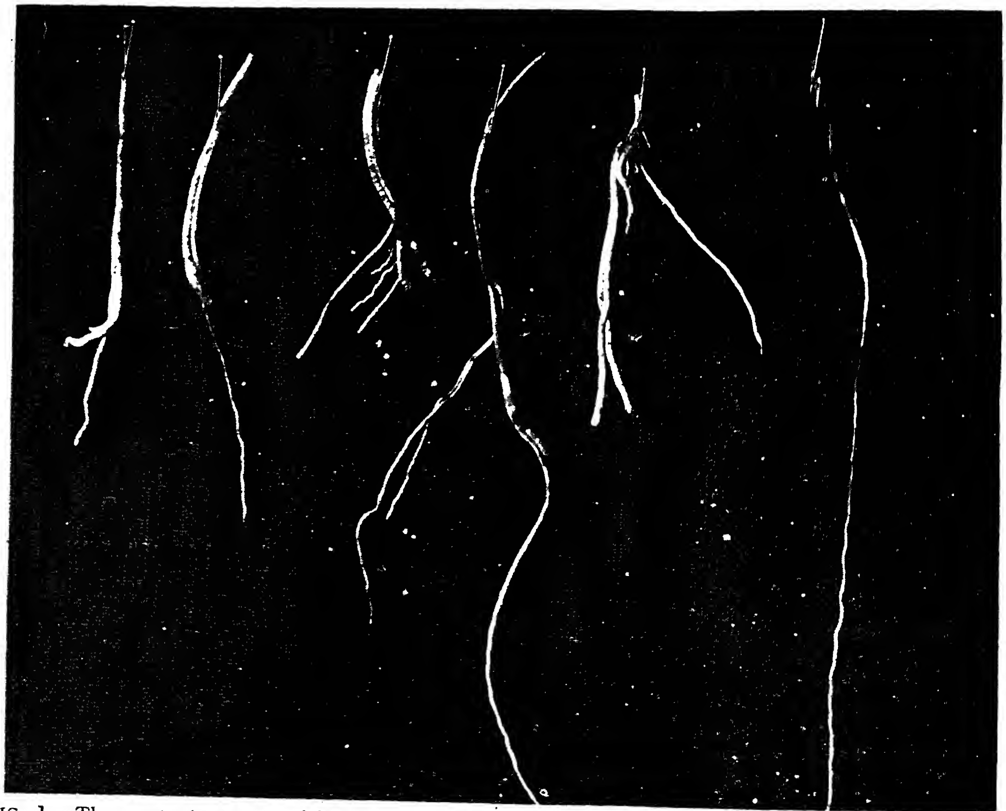


FIG. 1. The root at extreme right shows normal development consisting of a single cylindrical structure. To the left are examples in which two or more roots have become fused and show flattening.

FIG. 2. The root at the extreme right shows normal development of a group of roots at the lower end of an old root. These in turn have still younger roots at their lower extremity. The newly formed young roots are white in colour and the older roots are of darker shade. On the left are examples showing different degrees of fasciation. The second and 3rd from left are examples of extreme cases in which the structure cannot be easily recognised as root.

Fig. 2 is shown a series of fasciated roots in which the number of roots that have become fused to form the flattened structure progressively increases. In some due to unequal development of the roots so fused the entire structure has become twisted and curved (Fig. 2, second and third from left).

The fasciated aerial roots were observed on a number of *Banyan* trees growing on one of the sides of an avenue. A careful observation showed that on some trees even more extreme forms of fasciation than the ones illustrated in Fig. 2 were found to a considerable extent. On others fasciation was found to a much less extent and that too of a less complicated type as shown in Fig. 1. On some of the fasciated roots it was observed that normal roots were developing while in others fasciated roots produced fasciated ones. Along the same avenue the remaining trees were observed to produce only normal aerial roots and not a single fasciated root was found on them. Since the fasciated roots give rise to normal roots and *vice versa* it may be surmised that fasciation in aerial roots of *Banyan* is the result of some factor other than genetic.

College of Agriculture,
Poona, L. S. S. KUMAR.
June 16, 1944.

1. *Journal of the Bombay Natural History Society*, April 1942, **43**, No. 1, pp. 113-14.

POLARITY IN VACUOLATING DIVIDING CELLS IN *POLYGONUM ORIENTALE* L.

ATTENTION to this aspect of cell division was perhaps drawn for the first time in a more definite and clear manner by Sinnott and Bloch in 1941.[1] As a result of their studies in a wide range of vascular plants they came to the conclusion that wall formation in these cells is determined in early prophase by the position of the *phragmosome*, a more or less

continuous diaphragm formed by the aggregation of cytoplasmic strands holding the nucleus in suspension in the dividing cell (Fig. 3c). Thus long before the wall is laid down its position is determined by the position taken

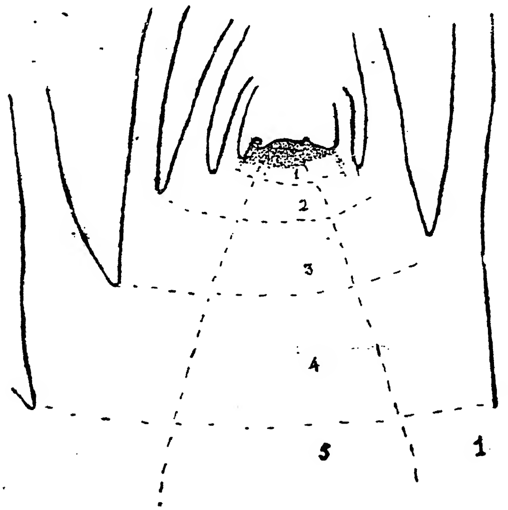


FIG. 1.—Longitudinal section of the growing apex showing the position of the apical meristem and the relative elongation of the internodes.

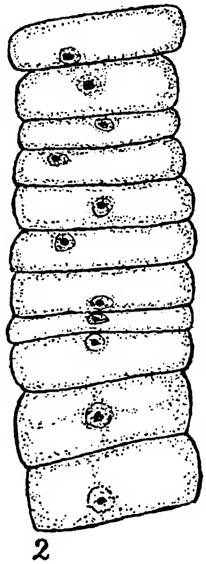
by the phragmosome. They said that "the first visible evidence of polarity of the cells is thus provided by the cytoplasmic configuration rather than by events in the nucleus" (p. 232).

During my anatomical studies on the shoot-apex organization in *Polygonum orientale* I have come across stages in the division of pith cells in the rapidly elongating internodes which are exactly similar to the stages given in Fig. 3 by Sinnot and Bloch.[2]

It appears that Sinnott and Bloch studied their materials in microtome preparations, but in addition to microtome preparations I have studied them in macerated material with very encouraging results. As direct maceration in 5 per cent. chromic acid caused heavy contraction of the protoplasm the shoot-apex was previously fixed in FAA solution before being macerated in 5 per cent. chromic acid. This pre-treatment caused much less contraction of the protoplasm than in the previous case. For examination at a later period the macerated material after being thoroughly washed in running water, was preserved in 30 per cent. alcohol.

Pith cells from the macerated apex were carefully separated out, stained in 1 per cent. aqueous eosin, 1 per cent. safranin solution and in Delafields hæmatoxylin, tried separately, and examined in 20 per cent. glycerine solution. A little pressure on the cover-slip causes the pith cells to separate in beautiful longitudinal files (Fig. 2).

Fig. 1, which is drawn from a microtome preparation, shows the distribution of the apical meristem and the relative elongation of the internodes (1-4) in the apical bud at the stage



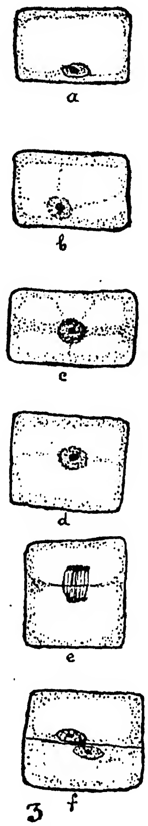


FIG. 2.—A file of vacuolating, dividing and expanding pith cells from the 4th. and 5th. internodes (macerated material). × 830.

FIG. 3.—*a—f*, showing the cells in division; position of phragmosome in *c*, determining the plane of the future cell wall, *d—f*. × 830.

when the section was cut. The apical meristem consists of a 3-layered *tunica*, and a central group of initials, the *corpus*; though the *flank* meristem is present the *rib* or *file* meristem of Schüepp and Priestley is absent. In the first and second internodes from the apex the division of the cells derived from the corpus and which ultimately would have given rise to the pith in the permanent region, are characterised by irregular divisions and the resulting cells though vacuolating and dividing, are not arranged in longitudinal series or files. In the third internode, near the base, the vacuolating dividing cells tend to assume a file organization, and in the fourth and fifth internodes, which are very rapidly elongating, these cells are fully organised in files, and their division now takes place exclusively by transverse walls. The pith cells of the fourth and fifth internodes form the ideal material for a study of the polarity of these cells. Fig. 2 shows an isolated file of the vacuolating and expanding pith cells from macerated material.

In Fig. 3 are given camera lucida drawings

of a few salient stages in the division of these cells. They are essentially the same as given by Sinnott and Bloch in their Fig. 3 (p. 227).

The results of the study of my material confirm the *phragmosome theory* of cell division in vacuolate plant cells as formulated by Sinnott and Bloch.[1]

Department of Botany,
Presidency College,
Calcutta,
May 11, 1944.
GOPAL CH. MITRA.

1. Sinnott, E. W. and R. Bloch, "Division in vacuolate plant cells," *Amer. Jour. Bot.*, 28: 225–232. 2. —, "The relative position of the cell walls in developing plant tissues," *Ibid.*, pp. 607—17 (for complete literature).

DUCTUS CAROTICUS IN THE PIGEON

In a pigeon dissected in the class in February 1944, I came across an abnormality in the arterial system due to the presence of the *Ductus caroticus.* A similar variation has just been observed in the Presidency College, Madras, and recorded in *Current Science.*[1] The only other record of such a variation which I could come across is one from Calcutta.[2] Since such variations are rather rare in the pigeon I give below a sketch of the dissection of the chief arterial vessels in this Trivandrum specimen.

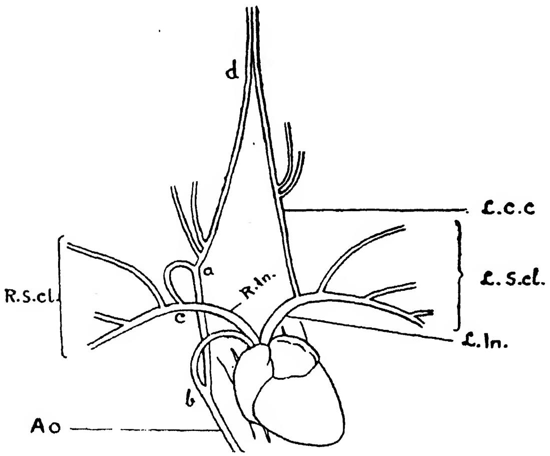


FIG. 1.—Ventral view of the arterial arches of the Trivandrum specimen referred to in the Text.

There can be no doubt that this variation represents the persistence of certain embryonic conditions which did not change while the other parts of the circulatory system changed to the adult arrangement. The part of the embryonic lateral dorsal aorta on the right side, between the third arch (Carotid) and the fourth arch (Systemic) has persisted as it does normally in *Sphenodon* and some of the lizards among the Reptilia and in the Apoda and some of the Urodela of the Amphibians. On the left side with the complete disappearance of the Systemic arch the corresponding part of the dorsal aorta on that side has completely disappeared.

It is interesting that this connection was quite as broad and full of blood as the basal part of the Carotid. The Carotid itself, while sufficiently broad at the base, became slightly narrower just beyond this connection but further beyond it got normal in size comparing with the Carotid of the other side. Judging from the figures of the other specimens it would appear that in them too, it was an open connection with clear blood flow.

Lillie[3] suggests as one of the causes for the disappearance of this part of the dorsal aorta in normal development, the reduction of the blood flow in it as the developing Carotid arch would draw off a forward current of blood and the Systemic would drain off backwards with little chance of blood flowing through this connecting part. A glance at the figure given here and the figure of the Presidency College specimen[1] would easily suggest a probable cause that has brought about the persistence of this part in these specimens: for here we find that the base of the Carotid has got bent downwards more or less, resulting in a flow of blood through this connecting region. This is not so well marked in the Calcutta specimen but still, even here there is a slight bend at the junction of the Carotid and the ductus.

Interpreting the Presidency College specimen Miss Subhapradha[1] looks upon the entire region from the *Innominate* to the *aortic arch* (c *a* b, Fig. 2 C) as the *Ductus caroticus.* As a result of this assumption she is faced with certain conclusions which as she correctly remarks are inexplicable embryologically. For instance, on this view it would appear that the *Ductus caroticus* connects the *Innominate* (or Subclavian) with the *aorta* and that the Carotid arises from the *Ductus caroticus!*

From a study of the three specimens I suggest another view which makes this anatomical peculiarity easily understood in the light of embryological development. To elucidate this I am giving diagrams of the arteries of the three specimens. The part of the *Ductus*

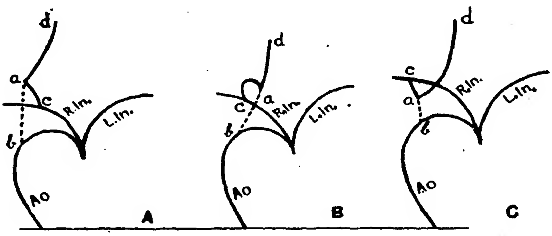


FIG. 2.—Diagrams of the three abnormal specimens recorded.

A—as in the Calcutta specimen.
B—as in the Trivandrum specimen.
C—as in the Madras specimen.

Ao, Aortic arch. *ab*, *Ductus caroticu.* *ca*, Basal part of the Right Common carotid. *d*, The Carotid. *L.cc*, Left Common Carotid. *L.In*, Left Innominate. *R.In.*, Right Inrominate. *L.S.cl*, Left Subclavian. *R.Scl.*, Right Subclavian.

caroticus from the *Innominate* to the point of origin of the right *Common Carotid* (*c a*) forms really the basal part of the *Carotid* itself, *i.e.*, the basal part of the *Carotid* has been bent backwards probably due to the backward pull by the contracting *ductus*. The remaining part alone (*a b*) which is rather short in the Presidency College specimen, connecting the *Carotid* with the *aortic arch* is the *Ductus caroticus.* This view brings these three abnormal specimens in the same category with varying degrees of contraction of the *Ductus caroticus* and explains the conditions in full accordance with embryological development. The Calcutta specimen would seem to represent the simplest condition with a typical *Ductus caroticus* (A, *a b*). The Trivandrum specimen would come next where the *Ductus caroticus* has contracted to a certain extent pulling the *Carotid* at its junction with the ductus slightly downwards (B, *a b*). In the Presidency College specimen which represents the extreme stage, (C, *a b*) the ductus has contracted considerably and the Carotid is pulled backwards from its very origin from the *Innominate* so as to bring the *ductus* and the base of the *Carotid* in a line. This apparent connection (C, *cab*) between the *Innominate* and the *aorta* is easily mistaken for the *Ductus caroticus* and the *Carotid* would then appear to arise from this connection! The backward displacement of the Vertebral and the œsophageal arteries on the right side is evidently the result of the pulling backward of the base of the Carotid due to the contraction of the *Ductus caroticus.*

This study also suggests that during the transition of the arteries from the embryonic to the adult condition one of the mechanical forces at work in bringing about atrophy of the unnecessary vessels is contraction, side by side with constriction. Under normal conditions where the connection becomes practically bloodless contraction would have only the effect of aggravating the constriction: but in these abnormal cases where the connection has full blood flow and grows side by side with the other parts of the circulatory system, contraction would pull the base of the *Carotid* backwards.

Zoology Laboratory,
University College,
Trivandrum, A. P. MATHEW.
June 1944.

1. *Curr. Sci.*, April, 1944. 2. *Anat. Anz. Bd.*, 1938, **80**, No. 7/10, 178. 3. Lillie, F. R., "The Development of the chick," 1919, 361.

ON THE BIONOMICS OF THE *LEIOGNATHIDAE**

SPECIES of *Leiognathus* and *Gazza*, popularly known as the Silver-Bellies, contribute to one of the important fisheries in the shallow sea around Pamban and Rameswaram from September of one year to May of the next year.

One thousand and one hundred and seventy specimens ranging in size from 4 to 16 cm. were examined in the laboratory of Krusadai Biological Station during the years 1941, 1942 and 1943. The following is the composition of the different species constituting the catches: *Leiognathus bindus* 40 per cent.; *L. equulus* 15 per cent.; *L. duara* 10 per cent.; *L. rucconius* 8 per cent.; *L. brevirostris* 4 per cent.; *L. insidiator* 3 per cent.; and *Gazza minuta* 20 per cent.

Food.—The diet consists entirely of plankton; but *Gazza minuta* occasionally feeds on fingerlings of the White-Bait (*Stolephorus* sp.). The following is the analysis of the planktonic food:—

Phytoplankton: (1) *Coscinodiscus*, (2) *Rhizosolenia*, (3) *Nitzschia*, (4) *Thalassiothrix*, (5) *Fragilaria*, (6) *Pleurosigma*, (7) *Biddulphia*, (8) *Detonula*, and (9) algal filaments.

Zooplankton: (1) Copepods, (2) *Rhopalophthalmus egregius*, (3) *Leucifer hanseni*, (4) Crustacean eggs, (5) Megalopa larvæ, (6) Ostracods, (7) Larval bivalves, (8) *Spiratella* spp., (9) *Foraminifers*, (10) *Ceratium* spp., and (11) Fish eggs of *Stolephorus* sp.

Spawning Season.—There are two spawning seasons, namely, November & December, and April & May.

Enemies.—Silver-Bellies form the natural food of the following carnivorous fishes: (1) the Black-finned Shark, *Carcharias melanopterus*, (2) the Seer, *Scomberomorus commersonii*, (3) the Jew-fishes, *Sciænaglauca* and *Otolithus ruber*, (4) the Ribbon Fish, *Trichiurus savala*, (5) the Horse Mackerel, *Caranx sansun*, (6) the Big-jawed Jumper, *Lactarius lactarius*, and (7) the Barracuda, *Sphyræna obtusata.*

Food Value.—The Silver-Bellies contain fine bones, and the flesh is scanty. Yet they are esteemed both in the fresh and sun-dried condition, the latter being considered as more palatable. The dried Silver-Bellies are of medicinal value, it being given to convalescents in general and to patients suffering from Malaria in particular.

Fisheries Section,
Dept. of Industries &
Commerce, Madras, P. I. CHACKO.
July 4, 1944.

* Published with the permission of the Director of Industries and Commerce, Madras.

FOOD OF THE INDIAN MACKEREL (RASTRELLIGER KANAGURTA RUSSELL) OF THE WEST COAST OF MADRAS PRESIDENCY[1]

"UPON the abundance of mackerel depends the welfare of many thousands of the citizens of Massachusetts and Maine." So observed Prof. Goode on the American mackerel fishery. So is the case with the mackerel of the West Coast of the Madras Presidency. The Indian mackerel (*Rastrelliger kanagurta* Russell) constitutes one of the important food fishes of the Malabar Coast.

A remarkable uniformity has been observed in the food of different species of mackerels in the different seas regarding the selection of food organisms at certain seasons of the year. So much has been observed on the uniformity of diet that the English mackerel fishermen take the colour of the water as an indication of the fishery. The colouration of the water is due to the abundance of certain types of planktonic organisms, just like the 'red water' of the Malabar Coast caused by the abundance of *Noctiluca* and *Peridinium*, the green water by *Trichodesmium, Coscinodiscus*, etc. The formula of E. J. Allan regarding the relation between the good catch of mackerel and a rich development of plankton consequent upon the sunshine has got a similar bearing on the mackerel fishery of our coast.

The food of mackerel, as revealed by the examination of stomach contents are soft and semi-solid in consistency but in a few cases granular. It will be of interest to know about the colour of the stomach contents. In the absence of any colour standard it will be premature to draw any specific conclusions regarding the colour produced by the presence of certain organisms and yet the presence of the following organisms is attributed to the different shades of colour of the contents in mackerel in a general way.

Light green: Dinoflagellates; Copepods; Infusorians.

Dark green: Dinoflagellates; Infusorians.

Greenish yellow: Dinoflagellates; Copepods; Diatoms.

Dark yellowish brown: Dinoflagellates; Diatoms; Copepods (in smaller numbers); Infusorians (in smaller numbers).

Dark greenish brown: Diatom; Infusorians; Copepods.

From the analysis it seems that the Dinoflagellates give the green colour, Diatoms yellowish tinge, and Copepods brownish tinge and the combination of these three in various proportions result in the various shades of the food contents.

The following organisms constitute the regular diet of the Indian mackerel (*Rastrelliger kanagurta* Russell):—

Phyto-plankton—

(1) Coscinodiscus: *C. jonesianus; C. oculusinidis; C. gigas; C. joneschii.* (2) Peridinians: *P. depressum*; *P. ovatum.* (3) Fragillaria. (4) Ceratium: *C. tripos*; *C. massiliense.* (5) *Thalassiothrix nitzschiodes.* (6) *Nitzschia* sp. (7) *Asterionella japonica.* (8) *Trichodesmium* sp. (9) *Rhizosolenia.* (10) *Pleurosigma.* (11) *Biddulphia.* (12) *Planktoniella.* (13) *Dinophysis homunculus.* (14) *Tintinnus.* (15) *Chætoceras.* (16) *Ditylum.* (17) *Planktoniella.*

Zoo-plankton—

(1) Copepods: *Paracalanus* sp.; *Euterpina* sp.; *Acartia* sp.; *Oithona* sp.; *Temora* sp. (2) *Evadne.* (3) *Leucifer.* (4) *Daphnids.* (5) Larval crustaceans. (6) Larval bivalves. (7) *Limacina* (a pelagic shell fish). (8) *Pteropods.* (9) Fish-eggs—(i) *Stolephorus* sp. (ii) Fish-scales. (iii) Bristle-worms.

Copepods.—The copepods along with larval crustaceans form the staple diet and constitute the bulk of its food. It is, therefore, supposed that mackerel closely follow the copepods, the abundance or paucity of which in the fishing zone may lead to a good or a poor fishery.

Fish-eggs.—Mackerel consumes regularly fish-eggs of the horse-mackerel, the Anchovy and the white bait. This feeding on fish-eggs may effect the fisheries of the fishes whose eggs the mackerel feed on.

Fish-scales.—Fish-scales have been found commonly included in the stomach contents of adult mackerel. Perhaps the fish supplements its planktonic diet by occasionally feeding on dead fish, as the adult has not been found to prey upon live-fish, unlike its European or American ally.

Stolephorus.—The inclusion of white-bait in stomach contents of young mackerel examined on a few occasions indicate the carnivorous habit of the young, while the adults are not.

Trichodesmium is said to fatten the mackerel and consequently it is believed that the taste of mackerel improves when this diatom occurs in large patches during March and April. This has been noticed in good quantities in the food of mackerel, during the month. The incidence of mortality of fishes by this algæ is more due to the asphyxiation caused by the dead decaying diatoms.[2]

The presence of these planktonic organisms in the sea in large numbers explains the abundance of the plankton-feeding fishes like mackerel and oil sardine. These animal organisms, copepods, depend upon the diatoms which in turn rely on the amount of "indispensable food substances" present in the sea and brought by the floods, rains and sunshine. Naturally it leads one to expect to forecast a good or bad fishery with the amount of rainfall, the quantity of nitrates, silicates and phosphates brought down into the sea and the amount of strong sunlight, besides various local ecological factors.

West Hill, K. CHIDHAMBARAM.
June 23, 1944.

---

1. Part of the work of the Fisheries Biological Station, West Hill.

With the kind permission of the Director of Industries and Commerce, Madras.

2. A separate note on this is being written.

REVIEWS

Clouds and Weather Phenomena. By C. J. P. Cave M.A. (Cambridge University Press), 1943. Pp. 1-22 and 42 illustrations. Price 5*sh*. net.

The text of this little book besides ecquainting the uninstructed reader with the natures and names of the various clouds that dapple or blot the sky, also gives accounts and explanations of sunset, moon's changes, rainbows, the mirage, haloes, coronæ, brocken spectres and condensation trails of high-flying planes. The 42 illustrations accompanying the book and illustrating the text are exceedingly good. This book was originally issued in 1926 and went through several reprints. This new edition, however, quite supersedes the old. The reading matter has been revised, augmented and re-set The illustrations have newly been made, many of them from fresh photographs. The book may be warmly commended to every one who is interested in the weather and who is not?

C. V. RAMAN.

Solvents. By Thos. H. Durram. (Monographs on Applied Chemistry Series.) Fifth Edition. (Chapman & Hall), 1944. Pp. xii + 202. Price 17/6.

In the revised and enlarged fifth edition, the author has striven to widen the utility of this well-known book, originally written to facilitate the intelligent use of solvents in the cellulose-lacquer industries. The general form of the book remains same as in previous editions, the book being divided into two parts, the first dealing with the scientific fundamentals underlying the choice of a solvent, and consisting of eight chapters devoted to a broad discussion of Solvent action, Solvent power and dilution ratios, Plasticising solvents and their functions, Solvent balance and determination of solvent compositions, Viscosity, Vapour pressure and evaporation rate, Inflammability and Toxicity. The causes underlying "cotton blush", "gum blush", "chilling", etc., are discussed lucidly. The reviewer refrains from cavilling at the redundancies in some of the physico-chemical explanations such as given on p. 31 for rates of evaporation, since the essential purpose of this part of the book to give an intelligent interpretation to the prevailing technical "practices" in the cellulose-laquer industries is, in the main, well served.

The second part of the book consists of nine chapters dealing somewhat comprehensively with the individual solvents grouped into Hydrocarbons and sundry solvents and Nitroparaffins, Alcohols and their ethers, Ketones, Esters, Glycols and their ethers, Cyclohexane derivatives, Chloro compounds, Furfurals, and Plasticising solvents. Where specifications of an official nature are prescribed, they are presented in a convenient abbreviated form for quick reference.

A list of Trade names and probable compositions, Solubility tables and a Plasticiser dosage table form three useful appendices to this well-written and neatly got-up monograph.

M. A. G. RAU.

Porcelain and Other Ceramic Insulating Materials, Vol I. By Dr. Ing. Ernst Rosenthal. (Chapman & Hall, Ltd., London), 1944. Pp. xii + 287 with 97 figures. Price 28 $ net.

Dr. Rosenthal is too well known in the field of ceramics to need any introduction to those interested in the subject. He was for many years the Technical Director of one of the largest porcelain organisations in Europe. His contribution to the development of the ceramic industry in general, and electro-porcelain in particular, are of the highest value. In view of the scarcity of literature on the subject (especially in English) and its importance in electrical engineering the book is most welcome and opportune.

The book gives a comprehensive survey of the entire field of electro-porcelain, its manufacture, characteristics and uses.

The book is divided into ten chapters.

The first four chapters are devoted to a general description of the structure and characteristics of electro-porcelain and other ceramic materials, such as those used for spark plugs, and how the manufacturing processes influence them. Reference is also made to the more important developments in the design of porcelain insulators and to the specifications adopted in different countries, especially the U.S.A. and Germany.

Chapters V, VI and VII deal with the raw materials used in the manufacture of porcelain, and the methods of testing them. In addition to the usual chemical and mechanical tests, the recently developed microscopic and X-ray analyses of raw materials and fired bodies are also briefly described. The latter tests are much more important for the manufacture of electro-porcelain than for other branches of ceramic industry.

The manufacture of porcelain is taken up in great detail in Chapter VIII. After describing the various processes and machinery involved during the several stages of manufacture, such as preparation of the body and glazes, shaping, drying, and firing, the latest developments in machinery, furnaces, and also the differences in manufacturing methods in various countries, are discussed. Special mention might perhaps be made of two features, *viz.*, (1) The Development of infra-red drying (in U.S.A.)—it is claimed that this gives appreciable saving in time and labour; and (2) The Development of new types of "Globar" elements without water-cooled terminals (for use in Electric tunnel kilns). This feature would materially bring down the cost of furnace operation.

The last two chapters deal with the various new ceramic materials developed in recent years for high frequency purposes such as those used for the manufacture of coil formers,

bases of trimmer condensers, valve and crystal holders, wave-range switches, variable inductances, high frequency condensers, etc.

The book is profusely illustrated and the printing and get-up are excellent, considering that it is a war-time publication.

The book will be found invaluable both to the ceramist who is interested in the manufacture of electro-porcelain and the electrical engineer interested in using it.

The second volume dealing in greater detail with the application of ceramic materials to the electrical industry is eagerly awaited.

H. N. Ramachandra Rao.

An Isovol Map of the South Wales Coalfield. Department of Scientific and Industrial Research: Fuel Research: Physical and Chemical Survey of the National Coal Resources No. 56. (H. M. Stationery Office, London), 1944. Isovol Map, price 1*s*. 3*d*.; descriptive pamphlet, price 6*d*.

This is the second of a series of papers in which data on the South Wales Coalfield are being published. The first (No. 55) dealt with the characters of the seams and showed in what directions changes in composition and ranks of coal took place. The paper (and map) under review shows particularly the change in the volatile content of the seams from place to place and the isovol lines deduced therefrom.

The paper accompanying the map describes how the data were collected and plotted and also discusses the relationship of the volatile matter to certain other properties such as carbon content, caking property and heating (calorific) value. The isovol map prepared in this manner is useful in respect of the ordinary bituminous coals but not anthracites. The latter contain only a small amount of volatiles but the percentage of hydrogen in the coal substance forms a good basis of classification. Certain simplifications have been adopted to get over difficulties connected with irregularities of the coal seams as the map would otherwise be unnecessarily complicated, and as perhaps several of the seams would then require individual treatment. The map and the explanatory text are complementary to each other and represent the result of study of much detailed information available on this important British Coalfield.

The work of Institutions like the Fuel Research Board, under whose auspices this has been issued, is a constant reminder to us in India of our colossal ignorance of the detailed properties of the materials which constitute our natural resources. M. S. K.

Polynesians—Explorers of the Pacific. By J. E. Weckler, Jr. (Smithsonian Institution War Background Studies, No. 6, Washington), 1943.

Long before the days of Columbus and the Vikings, Polynesian sailors in their double-hulled ships fashioned with stone tools explored the vast stretch of the sea extending from their original home near the Asiatic mainland to New Zealand, Hawaii and Easter Island, and possibly also they reached Peru. In this clear summary of the work of the leading ethnologists on Polynesian history and sociology, Mr. Weckler gives the public who are now specially interested in these islands because of their importance as theatres of war, an extremely readable account of the story of the Polynesian voyages of discovery as preserved in their myths and folk-lore. He also gives conclusive proofs to show that the voyages were well-planned and purposeful. The deleterious effects on the Polynesians of the early contact with European adventurers and the missionaries, and the manner in which the natives of Hawaii, New Zeland and Tonga are now reintegrating their lost cultures are described wih great sympathy in the concluding pages of the pamphlet. An alien rule is a continuous source of irritation to the Polynesians and Mr. Weckler's plea in this connection, addressed to his fellow Americans, is this: "The most fundamental freedom of all is the right to self-government. To be consistent with our ideals and to prove our sincerity to the world, we should prepare to give this privilege first of all to the disenfranchised peoples who are now under our dominion."

A. Aiyappan.

SCIENCE NOTES AND NEWS

The Ceylon Association of Science was formally inaugurated on the 29th July 1944 at a meeting of scientists held at the University of Ceylon. The Association is designed closely on the lines of the British Association for Advancement of Science, and the Indian Science Congress. As in the case of these other bodies the objects of the Ceylon Association of Science are the advancement of pure and applied science in the Island, holding of an Annual Session, and dissemination of scientific knowledge. Membership of the Association consists of three classes, *viz.*, Foundation Members, Sessional Members and Student Members.

Mr. D. N. Wadia, Ceylon Government Mineralogist and former President of the Indian Science Congress, was elected General President of the Association, and Dr. V. Gabriel, Senior Surgeon, General Hospital, Colombo, was elected the President-elect.

For the purpose of discussion at the Annual Session the following sections have been formed:—(1) Medical and Veterinary Sciences—*President*: Prof. W. A. E. Karunaratne; (2) Agriculture—*President*: Dr. R. V. Norris; (3) Engineering—*President*: Prof. R. H. Paul; (4) Natural Sciences—*President*: Very Rev. Fr. M. J. Le Goc; Physical Sciences: Prof. A.

Kandiah. Office-bearers for another section which includes Psychology, Social Sciences and Education have not yet been elected.

It is proposed to hold the first Session of the Association as early as possible in the coming year.

To encourage scientists to devote special attention to problems of colonial interest, a number of Colonial Research Fellowships have been instituted by the Secretary of State for Colonies. It is hoped that these would constitute the means of creating a cadre of scientists with special knowledge of environmental and social issues of the Colonies and that research on fundamental problems in tropical regions will be encouraged. These Fellowships will normally be for two years, but may be extended for a year and are tenable in any part of the British Colonial Empire. They are open to graduates under 35 years of age from any part of the British Commonwealth and the Empire and will carry an allowance of £400 to £600 per year. Provision has been made for 25 such fellowships within the next five years. The award of these Fellowships will be made by the Secretary of State for Colonies on the advice of the Colonial Research Committee.

With a view to train specialists in diplomacy and foreign trade, the Moscow University has created a new course in International Relations. It is a five-year course and students are expected to specialise in detailed study of history, tradition and contemporary conditions of individual States.

A scheme for starting a Medical College in the Benares Hindu University is understood to have been prepared. The scheme will be submitted to the Gwyer Committee for approval and thereafter the Government will be moved for permission.

The thirteenth annual convention of Sugar Technologists' Association of India will be held in Cawnpore on September 16 and 17 in collaboration with the annual general meeting of the Indian Sugar Mills Association of Calcutta. Scientific papers dealing with original research and some other problems connected with the sugar industry will be discussed at the convention.

Short notes on Industrial Topics, both technical and of news value, are invited on payment basis for publication in the "Technical Research Notes" and "Notes and News" sections of the Industrial and News Edition of the *Journal of the Indian Chemical Society*. For each note approved for publication Rs. 2 will be paid. None of the notes, approved or unapproved, will be returned unless accompanied with requisite postage stamp. Further information can be had from the Hon. Secretary, Indian Chemical Society, P.O. Box 10857, Calcutta.

At the seventh meeting of the Governing Body of the Council of Scientific and Industrial Research held in New Delhi on August 1, 1944, it was decided that the Silicate and Glass Research Institute should be located at Calcutta and that its construction and equipment should be taken in hand forthwith. A sum of Rs. 14,000 was sanctioned to meet the cost of nucleus staff for the Institute for the current financial year. Two scholarships for foreign study of glass and porcelain subjects were also sanctioned. The Governing Body expressed their grateful thanks to Dr. Sir U. N. Brahmachari, Mr. I. D. Varshney (President, U.P. Glass Manufacturers' Association), and the Bengal Glass Manufacturers' Association, for the donation of Rs. 10,000 that each one had made towards the cost of the Institute. The question of the selection of a site for the National Physical Laboratories was discussed. The final decision was left over until the matter had again been examined by the National Physical Laboratories Committee. The Governing Body recorded their appreciation of the generous gift of 100 acres of land made by the Raja of Jharia for the construction of the Fuel Research Station at Dhanbad. A post of an Assistant Director of Planning for the purpose was sanctioned. The Governing Body noted with interest the progress made with regard to other two research institutes, *i.e.*, National Chemical Laboratories and National Metallurgical Institute.

A sum of about one lakh of rupees was sanctioned for research on the following new schemes: manufacture of resistance alloys; preparation of alkali and water-soluble ethyl cellulose; investigation on essential oils of C.P. and Berar; manufacture of graphite crucibles "Ferrous"; study of conditions favouring the increase of alcohol concentrations in the fermented distillery wash from the present average of 7 per cent. to 10 per cent. or 12 per cent. by volume; manufacture of Aluminium titanium alloys; manufacture of porcelain containers for hydrogen peroxide; pilot plant experiments on the manufacture of sodium and magnesium metals by electrochemical methods; scheme for the setting up of medium voltage positive ray discharge tube for the investigation of nuclear disintegration; development of air-driven ultra centrifuge for physical, chemical and biological work; and investigation on electrical properties of some typical order, disorder alloys, particularly in the neighbourhood of their Curie temperatures and on the influence of quenching on these properties.

The Health Survey and Development Committee, constituted under the auspices of the Government of India, has had under consideration the question of revising the medical curriculum so as to shed much of the unnecessary load that is placed on the medical student and of improving the content of the subjects taught and the method of teaching, particularly for the purpose of giving a preventive bias to the outlook of the student. The proposed changes in the curriculum will, it is hoped, enable the doctor of the future to offer to the people of India both curative and preventive health service in an effective manner.

Other subjects considered by the Committee

(which, with its sub-cimmittees, held meetings between July 1 and 15) included the place of the indigenous systems of medicine and of homeopathy in the future programme of medical relief for the country, the health of the school population, the control of venereal diseases, prevention of smallpox, physical education, health education and publicity, the problem of nutrition and control of food adulteration.

Groups of members of the Committee will shortly undertake tours in the provinces of Delhi, the U.P., Bihar, Orissa, Bengal and the C.P. Industrial centres in Northern India will also be visited. These tours will complete the rapid survey of existing health conditions in British India by the Committee, that has been in progress during the past few months.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory during the month of July 1944, there were four of slight and one of moderate intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin (I.S.T.)	Epicentral distance from Bombay	Co-ordinates of epicentre	Depth of focus
		H. M.	(Miles)		(Miles)
17	Slight	17 24	2180	..	..
19	Slight	16 51	4330	.	..
23	Slight	18 28	1300	..	..
27	Slight	06 34	6420	..	.
27	Moderate	14 49	1480	Lat. 11°·7 N., Long 95°·OE. near the Andaman Islands.	110

MAGNETIC NOTES

Magnetic conditions during June 1944 were slightly more disturbed than in the previous month. There were 20 *quiet* days and 10 days of *slight* disturbance as against 20 quiet days and 10 days of slight disturbance during the same month last year.

The quietest day during the month was the 24th and the day of the largest disturbance the 15th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days
	Slight
1–3, 6–8, 10–12, 16–21 24, 25, 27, 28, 30	4, 5, 9, 13–15, 22, 23, 26, 29

No magnetic storm occurred during the month of June in 1943 and 1944.

The mean character figure for the month of June 1944 was 0·33 as against 0·67 for June 1943.

Magnetic conditions during July 1944 were less disturbed than in the previous month. There were 27 *quiet* days and 4 days of *slight* disturbance, as against 7 quiet days and 24 days of slight disturbance during the same month last year.

The quietest day during the month was the 25th and the day of largest disturbance was the 9th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days
	Slight
1–8, 10–13, 15–18, 21–31	9, 14, 19, 20

No magnetic storm occurred during the month of July in 1943 and 1944.

The mean character figure for the month of July 1944 was 0·13 as against 0·77 for July 1943.

M. PANDURANGA RAO.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 92, No. 4665.

"Journal of Agricultural Research," Vol. 68, Nos. 5-6.

"Agricultural Gazette of New South Wales," Vol. 55, Nos. 1 to 4.

"Endeavour," Vol. 3, No. 10.

"Experiment Station Record," Vol. 90, No. 4.

"Transactions of the Faraday Society," Vol. 40, Pt. 5.

"Indian Forester," Vol. 70, No. 7.

"Horticultural Abstracts," Vol. 13, No. 4; Vol. 14, No. 1.

"The Indian Journal of Horticulture," Vol. 1, No. 2.

"Central Board of Irrigation Bulletin," Vol. 1, No. 3.

"Bulletin of the Indian Central Jute Committee," Vol. 6, Nos. 11-12; Vol. 7, Nos. 2-3.

"Transactions of the Mining, Geological and Metallurgical Institute of India," Vol. 39, Nos. 2-3.

"Indian Medical Gazette," Vol. 79, No. 6.

"The Review of Applied Mycology," Vol. 23, Nos. 3-4.

"Bulletin of the American Meteorological Society," Vol. 25, No. 2.

BOOKS

The Application of Radiant Heat of Metal Finishing—A Critical Survey of the Infra-Red Process for the Storing of Paints and Enamels. By J. H. Nelson. (Chapman and Hall, Ltd., London, W.C. 2), 1944. Pp. 79. Price 8*sh.* 6*d.*

Metallurgical Analysis. By V. Gopalam Iyer, (Benares Hindu University), 1943. Pp. 365 + 11. Price Rs. 12.

ERRATA

Vol. 13, *No.* 7:

Page 177, Contents, right column, 9th line: *Read* "Ovule" *for* "Value".

Page 186, heading of Note entitled "The Origin of the Haustoria .....", etc.: *Read* "Ovule" *for* "Value".

919-44—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

CURRENT SCIENCE

Vol. XIII] SEPTEMBER 1944 [No. 9

BREEDING GOATS AND SHEEP FOR MILK PRODUCTION

THAT India produces milk much below her requirements is now a well-accepted fact. One of the main contributing factors is insufficiency of fodder to maintain the country's comparatively large cattle population. This has gradually led to the steady degeneration of cattle. This state of affairs is reflected in the acute shortage of milk which is being universally experienced during the present emergency, when, even the small supply of milk available to the general public is of very doubtful quality. The two alternatives for remedying this are either to import large quantities of dried and condensed milk which is bound to further deteriorate the milk problem of the country, or to devise ways and means for lowering the cost of production. The best way in which the latter can be achieved is to keep smaller animals than the cow and the buffalo, which are more efficient as milk producers. An average village cow may be estimated to consume a minimum of about 30 lbs. of roughages and 2 lbs. of concentrates per day and produce 2½ lbs. of milk. On the other hand a small animal like the goat consuming about one-fourth this quantity of food will give, if not the same quantity of milk, relatively much better yields. Thus there is a distinct possibility of easing the milk problem of the country with the available quantities of fodder. The problem of fodder production is such that apart from the present war conditions, no immediate solution can be expected even in the post-war period. It cannot of course be suggested that goats should entirely replace cows and buffaloes. What is implied is that only the better quality of bigger animals should be maintained, and with the food that is saved probably the maintenance of two or three smaller animals would prove more economical. Further, there are many waste lands where big animals like the cow and the buffalo cannot thrive and this can be profitably employed for rearing goats.

Normally India maintains a good size of goat population, *viz.*, about sixty million goats. Of these, many are of the meat variety but a few breeds like the Surti, the Jumana Pari, the Bar-Bari, the Kamori and the Cutchi, possess good milking potentialities. Most of these animals are not properly maintained and looked after. Although goat-keeping has been practised since the earliest time, breeding according to a definite plan does not seem to have received adequate attention. On an average, country goats yield about a pound of milk per day over a lactation period of about 160 days. With reasonable care this output can at least be increased threefold in a short period. The goat has been commonly termed "the poor man's cow". However, if let free by itself it may well prove a poor man's ruin. Under village conditions goats are left grazing in the open and this is supplemented by leaves of trees and shrubs. Goats love browsing and if left without any supervision they will destroy all vegetation. But this accusation may be directed against almost any animal and it is quite essential that their movements should be controlled.

Though goat is a browser, it can easily be accustomed to stall-feeding. Further, goats will take a wide variety of feeds normally not consumed by other animals, *e.g.*, leaves of trees. A goat is a hardy animal which can be accommodated in a small space and two good milking goats will well serve the needs of an average family. Many of the city dwellers cannot possibly keep a big animal like a cow, but can manage to find place for a goat. Should this suggestion be widely accepted and put into practice, it will go a long way to supply an important part of the nutritional requirements of families with low incomes. In every city or town there are small plots of land on which some fodder can be grown and utilised for keeping goats, thus saving a portion of the wages earned, which would be

otherwise spent on what now happens to constitute one of the most expensive items of diet. Thus goat-keeping can play a vital part in building up the health and vitality of the nation, which have been undermined through years of malnutrition and disease.

Systematic breeding of milk-goats has long been neglected in India. In Central Europe, where milk-goats are very popular, an average yield of 1,600 lbs. of milk per annum is considered as the normal output. Good milch goats with an annual milk yield of 3,000-4,000 lbs. are not uncommon. In India some work on improving the milking qualities of goat has been taken up recently by Government organizations. The number of agencies, the number of animals and the duration of the work are so small that hardly any effects of these enterprises will be felt by the public at large. What is needed is that milk-goat breeding should be taken up as a national and vital necessity by the middle classes all over the country. The results of the few experiments that have been carried out are quite encouraging. Country goats by selective breeding have given about 40 per cent. more milk in the third generation. In a few cases as high as 1,100 lbs. of milk covering a lactation period of 210 days has been recorded. Thus, it is possible to improve the performance of our goats with a little care and attention. The principal and immediate object of any scheme to further goat-keeping and breeding should be to obtain animals with as high a yield as possible rather than standardising their form and colour. In the beginning cross-breeding with imported stock may also prove useful.

In some cases, prejudice exists against the use of goat milk. One of the commonest is attributed to flavour. This is largely due to unhygienic conditions in which milk is produced rather than to any inherent defects. The nature of food given will also play some part. Nutritionally, goat milk is as valuable as, if not more than, that from cow or buffalo. On an average it is richer in fat than cow's milk. There is also a belief that domesticated goats are very susceptible to diseases. But here again there is no scientific evidence to support this conclusion. Goat milk is well-known to be normally free from tuberculosis germs. Besides, milk-goats have been kept under domesticated conditions in other countries and there is no reason why India should be an exception.

There is yet another animal whose possible potentialities for milk production have not been explored in this country and that is sheep. India has a sheep population of nearly thirty millions. Of these the Lohi, the Kuka, the Kathiawar, the Hashtnagri, the Gurez and the Balkhi are known to be good yielders and regularly milked. Ewes of these breeds yield on an average 1-2 lbs. of milk per day and yields as high as 8 lbs. per day have been recorded. From the above breeds the Kuka, and the Lohi are the best and their average daily yield will easily come to 2-3 lbs. If these breeds are systematically developed they will prove as profitable as goats. Sheep milk is also very rich in fat.

For meeting the immediate milk requirements of the country the rearing of goats and sheep should be taken up seriously. The initial cost as well as the maintenance cost of these animals will probably amount to one-fifth of the money spent after bigger animals for whose maintenance it is difficult to find enough food. To make a start in this line the object should be high milk production even though resort has to be taken to cross-breeding. If rearing of these animals is taken up by the poorer classes in urban centres on a co-operative basis, the possible benefits that can be obtained are unlimited. Besides milk, these animals yield wool or hair, mutton, skin and manure. Thus they will repay their cost in a very short time. We have no doubt that this problem will receive the attention of the Imperial Council of Agricultural Research.

MAN'S MOST CREATIVE YEARS—THEN AND NOW

At what age do eminent men make their most significant contributions: Is this age the same for various periods in the history of thought? Lehman approached these questions by plotting age-of-best-production curves for 15 different fields. His study of physicists is typical. He chose 89 deceased physicists listed in a source book of physics, and found that 45 of them were born before 1785, and the other 44 between 1785 and 1867. He then plotted the number of major contributions made by each group in successive decades of life. To compensate for early deaths, he converted the data to percentages. The early group of physicists made its highest percentage of great contributions between the ages of 40 and 50, and then showed a rapid decline in quality of work. But the more recent group reached its crest between 30 and 40. In fact, the "recent" curve is almost identical with the "early" curve, except that it is shifted ten years ahead.

Similar results were obtained for geology, mathematics, inventors, botany, pathology. "Description of Diseases", medicine, philosophy, literature, education, economics and political science. In all 12 fields the greatest contributions of the most eminent men seem to come at an earlier age than they did a century ago. This also held true for a group of 250 minor economists and political scientists. But in chemistry and oil painting the age curves for the two periods coincide. Lehman has no certain explanation of his findings, but thinks speedier publication, stimulation and better opportunities favour the more recent men. At least his results show clearly that young contributors have just as good a chance now as they ever did.

(By courtesy of *Science*, 1943, 98, 393-99.)

ESTIMATION OF CROP YIELDS

By V. G. PANSE[1] and R. J. KALAMKAR[2]

In a previous article in this *Journal* (May 1944), the authors had briefly reviewed the problem of forecasting and estimating yields of agricultural crops, and had described an experiment carried out in Akola district in Berar to estimate the yield of cotton in that district in the season 1942-43. The experiment illustrates the method of investigating the problem in that its design enables us to secure technical information on the strength of which future surveys may be planned more efficiently.

The results of the experiment in Akola indicated that it was sufficient to harvest only one plot per field; but a larger number of fields per village would lead to an increased accuracy of the yield estimate. The effect of plot size on accuracy was not appreciable and a change in the present plot size of one-tenth acre was, therefore, not considered necessary. Following these conclusions, the experiment was repeated in Akola district in the year 1943-44, with only one plot of one-tenth acre size (35′ × 132′) per field but selecting four fields instead of two per village while keeping the number of villages the same as in the previous year, *viz.*, ten in each *tahsil*. These modifications simplified the plan of sampling and at the same time a more accurate estimate of yield was anticipated without any increase in the amount of work or in the cost of survey. To verify the results relating to the sampling technique, another survey was simultaneously carried out in the adjoining district of Buldana with the same design that was adopted in the Akola experiment in 1942-43, *i.e.*, selecting ten random villages per *tahsil*, two random cotton fields per village and two random plots of three-tenth acre size per field, each plot subdivided into six longitudinal sections of one-twentieth acre. There are five *tahsils* and 1364 villages in Buldana district and the fifty villages selected for the survey formed a 3·7 per cent. sample of all villages in the district.

The two districts have a common boundary between them and an important feature of this year's survey was that an independent arrangement was made to find out the total production of cotton in both districts through ginning factory returns. Ginning factory owners are required by law, to submit weekly returns of the amount of cotton ginned throughout the season, but these figures cannot by themselves represent the actual production of cotton in the district as some unginned cotton may be consumed domestically or held over until the next season, while cotton may be brought in from outside and ginned in the district or unginned cotton may be exported from the district. Ginning returns must be corrected for these factors before the figure for the total production of cotton in the district can be arrived at. Careful enquiries into these factors were made by the district land records and revenue staff under the direction of the Director of the Land Records Department, who had set up a particularly effective organization to register all cotton traffic crossing the borders of these two districts. An alternative estimate of total production may be based on the registration of cotton carts arriving at the cotton markets. All cotton markets in Berar maintain this information; but it is usually incomplete as some cotton carts do not go to the market or are sold at centres where there is a ginning factory but no cotton market. Ginning returns thus form a more reliable basis for calculating total production.

The value of an independent check of this kind for verifying the results of crop cutting experiments made on randomly selected plots is obvious. Though such experiments have sound statistical theory behind them and are designed to give an unbiassed estimate of yield with a determinable accuracy, it is desirable to demonstrate their reliability in a manner that administrators and other practical men can appreciate easily and thereby provide convincing evidence of the efficacy of the method. A random sampling survey will then be preferred to alternative procedures involving a complete census of production on account of its greater simplicity, less cost and the availability of the results within a short time after harvest is over, this last being the most important advantage from the commercial view-point.

The two districts in which the survey was carried out in 1943-44 occupy an area of 7,857 sq. miles. Cotton was grown over 11 lacs of acres during the season which represents slightly more than one-third of the area under cotton in the whole Province. The total cost of the scheme was Rs. 18,000 of which roughly two-thirds was spent on the crop cutting experiments and one-third on the registration of the cotton traffic across the borders of the two districts.

The analysis of variance of plot yields in each *tahsil* pooled over the whole district is shown below for the two districts.

Analysis of variance of plot yields

Due to	Akola district*		Buldana district†	
	Degrees of freedom	Mean sq.	Degrees of freedom	Mean sq.
Villages	54	386·2	45	6836
Fields ..	180	212·5	50	4334
Plots ..	..	..	100	407

* 1/10 acre plots; † 3/10 acre plots (Sum of six 1/20 acre sections).

The last item is blank in Akola because there was only one plot per field. Mean squares for Buldana may be made comparable to those

[1] Institute of Plant Industry, Indore.
[2] Department of Agriculture, Central Provinces, Nagpur.

for Akola by dividing by 9. As in the last year, the predominant portion of the total variation in yield is that due to differences between fields in the same village. Last year the village mean square in Akola district was roughly 1·4 times the mean square for fields, as compared to the ratios of 1·8 and 1·6 in Akola and Buldana this year. The mean square due to fields is 10·7 times that for plots in Buldana. This ratio was 7·5 in Akola last year. Thus, while the absolute magnitude of variation from different sources may differ rather widely from season to season and from district to district, its relative magnitude appears to remain approximately of the same order. This latter fact makes it possible to devise an efficient sampling technique suitable for general application over the rainfed cotton tract of peninsular India and to serve as a reasonable basic design in extending the yield survey to the irrigated tracts. Results with different plot sizes in Buldana confirm the conclusion derived from a similar study in Akola last year, *viz.*, that the choice of a particular plot size in preference to another within the range tried is not likely to be of any importance in increasing the accuracy of mean yield. The plot size of one-tenth acre at present in use will, therefore, be adopted in future surveys.

The average yield of kapas (seed-cotton) per acre was estimated at 282 lbs. per acre in Akola and 299 lbs. per acre in Buldana districts. These estimates are subject to standard errors of 4·7 per cent. and 6·7 per cent. respectively. The standard error in Akola was 6·3 per cent. last year, and the modifications made in the plan of sampling have resulted in greater accuracy which was anticipated. The standard of precision in Buldana is approximately the same as was attained in Akola with an identical sampling design last year. The official estimate of yield was 248 lbs. per acre for Akola and 253 lbs. for Buldana. These figures are 10 and 17 per cent. lower than the corresponding experimental estimates. The district revenue and agricultrual staff who were asked to inspect the crop of the fields selected for the survey also under-estimated the yield. It will be remembered that last year when the yield was poor (136 lbs. per acre) it was grossly over-estimated by the same agencies. Yields are thus over-estimated when they are poor and under-estimated when they are really good. This is an expected consequence of the tendency not to deviate widely from the "normal" yield—the 'thirteen-anna' complex as it is sometimes described.

The inquiry made by the Director of Land Records into the total production of kapas in these two districts gave the following results.

In converting the figures for lint supplied by the ginning factories into those of kapas, a conventional ginning percentage of 33·3 is usually adopted. This causes considerable error due to seasonal and varietal variation in ginning percentage. The improved variety, Jarila, which had spread to 67 per cent. of the cotton area in Akola and 89 per cent. area in Buldana was found to have a ginning percentage of 37·5 in this particular season. This fact was taken into account in arriving at the figure for *kapas* ginned. It may be noted incidentally that according to the information

	Akola district	Buldana district
	kandies*	kandies
Kapas ginned	204520	236794
Net import of unginned kapas ..	..	44961
Net export of unginned kapas ..	20015	..
Carry over to next season ..	1823	2203
Total production of kapas in the district	226358	194036
	acres	acres
Area under cotton at final forecast	588183	513376
Yield of kapas per acre ..	301·7 lbs.	296·3 lbs.

* 1 kandi = 784 lbs.

carefully collected regarding the variety of cotton grown in the fields selected for the crop cutting experiments, 69 per cent. of the fields in Akola and 94 per cent. in Buldana grew Jarila. These proportions are in close agreement with the above proportion of Jarila obtained through the usual field inspection by the district land records staff, and demonstrate the representativeness of the fields selected for the crop cutting survey.

There was a considerable cotton traffic across the district borders and, due to the popularity of cotton markets in Buldana, cultivators from afar brought their cotton into this district for sale. The largest import was from the neighbouring district of Akola, amounting to over 32,000 kandies of kapas. In computing figures for import and export from primary data, factors such as the relation between local weights and standard weights and the discrepancies between the reported weight and the true weight of a cartload of cotton had to be taken into account. The report of the Director of Land Records contains several interesting details connected with this work. Carryover of unginned kapas to next season was quite small. Figures for the carryover from the previous season were not collected as being negligible owing to the high prices of the previous season. The inquiry into the domestic consumption of cotton is not yet complete though here again the amount of cotton involved is thought to be trifling. The movement of kapas is apparently the most important factor affecting ginning returns. On the information available, the calculated yield per acre for Buldana shows a very close agreement indeed with the estimate obtained from the crop cutting survey, while in Akola the calculated yield is quite within the limits upto which the yield estimate from crop cutting may fluctuate through chance cuases, these limits (281·6 ± 26·4) being defined by the standard error. We may conclude that in both districts the reliability of the yield estimates derived from the crop cutting survey has been amply borne out through a comprehensive independent check.

The degree of accuracy to be aimed at in planning future surveys needs some consideration. The trade is interested in accurate production estimates of large blocks comprising of several districts, rather than of individual districts. The past two seasons' surveys were limited to one or two districts and a standard error of the order of 5 per cent. of the mean yield was reached. In extending the survey to larger areas, a higher degree of accuracy which would reduce the margin of error is clearly necessary to ensure trustworthiness of the estimate for practical purposes. Estimates with a standard error of only one per cent. may be reasonably demanded, but it does not seem possible to attain this degree of accuracy for rainfed cotton without excessive sampling. The amount of sampling needed for estimating the yield with varying degrees of accuracy, as indicated from past results, is shown below:

Number of villages required for survey with four fields per village and one plot of one-tenth acre size per field

	1% s.c.	2% s.c.	3% s.c.
Akola results, 1942–43 ..	1850	463	206
Akola results, 1943–44 ..	1188	297	132
Buldana results, 1943–44 ..	1556	389	173

With four fields to be sample-harvested in each village, crop cutting will have to be done in upwards of twelve hundred villages in each block whose production is required to be estimated with a standard error of one per cent. The cost will ordinarily be prohibitive. In Central Provinces and Berar where cotton is grown in 34 *tahsils* in ten districts, this will mean harvesting sample plots in some 35 to 40 villages in each *tahsil.* On the other hand, a slightly lower standard of accuracy seems attainable in practice. Enough sampling can be managed to estimate yield with a standard error between 2 and 3 per cent. In irrigated areas and with less variable crops than cotton such as cereals, the position is probably better. Crop cutting experiments carried out on rain-fed wheat in Central Provinces and on irrigated wheat in the Punjab in the year 1943-44 have indicated that a definitely higher standard of accuracy than is attainable with rainfed cotton can be aimed at in planning yield surveys on cereals particularly in irrigated tracts.

With the object of estimating the average yield and the total production over the whole cotton area in Central Provinces and Berar, it is proposed to carry out a crop cutting survey in the current season at an estimated cost of Rs. 35,627. This will serve as a large-scale demonsrtation of the method. When the operations are taken up as a routine by the regular staff of the departments concerned, the cost will be considerably reduced. In order to train the personnel, part of the field staff in this year's survey is to be recruited from the Land Records Department while additional district staff from the revenue and agricultural departments will be trained during the progress of the field work. The survey will extend over 29,829 sq. miles and cover approximately three million acres under cotton representing over 99 per cent. of the total provincial area under this crop. Six random villages per *tahsil* on an average, or 204 villages in all, will be selected and a single plot of one-tenth acre size will be harvested in four cotton fields in each village. The actual number of villages to be selected will be distributed among the different *tahsils* in accordance with the area under cotton in each *tahsil.* This will increase the accuracy of the final estimate by reducing the error of the yield estimate in those *tahsils,* where there is a larger acreage under cotton. The projected survey will form the first step in the right direction in estimating by a reliable technique the production of the most important commercial crop in the country and it is to be hoped that the method will be rapidly extended for estimating yield of all principal crops.

The cotton surveys in Akola and Buldana districts were financed by the Indian Central Cotton Committee.

It is a pleasure to acknowledge the help given by Mr. M. I. Rahim, I.C.S., Director, Land Records, Central Provinces and Berar, which contributed materially to the successful prosecution of the present surveys.

A RAPID METHOD FOR THE MECHANICAL ANALYSIS OF SOILS FOR EXTENSIVE SOIL SURVEY WORK

By N. D. VYAS and K. C. BATRA

(Imperial Agricultural Research Institute, New Delhi)

FOR carrying out soil survey of the agricultural stations and sub-stations under the control of the Imperial Agricultural Research Institute, New Delhi, some method for the mechanical analysis of soil had to be adopted. Of the methods in vogue, the one known as Puri's method has gained much importance because of its rapidity and is probably one of the best methods so far as its applicability to pedological studies is concerned, but from practical point of view, this presents certain drawbacks. In the first place the whole of the soil clay is converted into sodium clay and thus it does not show actual field behaviour. Secondly the saturation capacity of a soil or its moisture equivalent,* which bear close relationship with the clay content do not show any relationship with the clay content obtained by Puri's method. On the other hand, such relationship is clearly brought out when the clay is estimated by the old Beaker method. Thirdly, the method appeared to be lengthy for examining a large number of soil samples at a stretch. It was, therefore, decided that a method which could give comparable results with that obtained by the beaker method

be adopted for the work in question. The greatest disadvantage in the beaker method for which it could not be adopted was the consumption of time. Examination of some of the soils showed that it takes nearly two to three weeks to complete a set of samples. To overcome this it was thought that if the process is reversed probably much time could be saved. Instead of estimating clay followed by silt and sand as in the beaker method it was proposed to estimate sand followed by silt while the clay fraction could be obtained by difference. For this some samples of Delhi soils were examined by both the methods. The results obtained were so concordant that examination of the applicability of the method to other soils was considered desirable. The test was, therefore, carried out with about a dozen soils, collected from the different stations in India. The samples were examined by both the methods, the beaker method and the new method which can be designated as "Beaker-Basin method". The details of these results are given below.

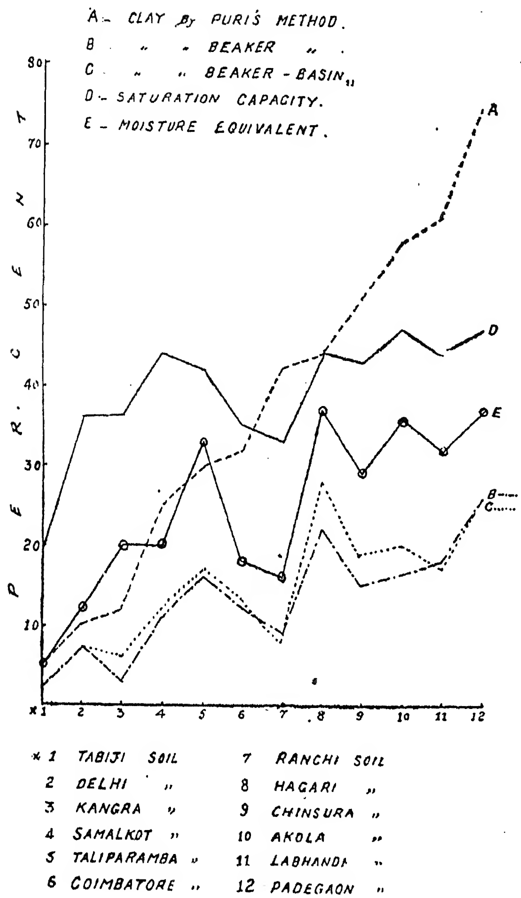
The Beaker Method.—10 gms. of air-dry soil, sieved through 2 mm. sieve, were transferred to 200 c.c. rubber-stoppered cylinder, containing 200 c.c. distilled water. After shaking half a dozen times upside down the cylinder was allowed to stand overnight. Next morning it was put in an end-to-end overshaker for 6 hours.† The contents were then transferred to elutriation beaker 15 cm. in height and 7·75 cm. in diameter. The volume of the contents was then made upto 10 cm. height with water. The contents were stirred with a rubber-capped glass rod and allowed to stand for 24 hours. The supernatant liquid was then syphoned off and the operation was repeated number of times till the supernatant became clear. Every day's collection of the syphoned liquid was dried in the same dish over the water-bath and finally at 100° C. for 24 hours and then weighed. In this way the total clay content was estimated and not the aliquot as is frequenly done. To the beaker water was added to make up the volume to 10 cm. height. After stirring, the sand was allowed to settle for a specified time as allowed in the international method, depending on the temperature of the water used. The silt was syphoned off and collected in specimen jars of 4-litre capacity. The operation was repeated till the supernatant liquid became clear. The sediment in the beaker was dried and weighed as sand. The silt was determined in the syphoned liquid by allowing it to stand for 24 hours for each 10 cm. height. The clear supernatant liquid was thrown out and the sediment was dried and weighed as silt.

The Beaker-Basin Method.—All the preliminaries upto the transfer of the contents from the cylinder to the beaker were the same as mentioned above in the beaker method. After making up the volume to 10 cm. and stirring, the liquid was allowed to stand for a specified time as recommended, for the settling of sand, in the International method.‡ To be a bit cautious the first two pourings were made after five minutes' standing and the later ones according to the specified time. The operation as usual in such cases was repeated till the supernatant liquid became clear. The residue was dried at 100° C. and weighed as sand. The syphoned liquid containing the silt and the clay was collected in an enamelled basin of five and a half litre capacity with nearly 35 cm. diameter with erect wall so that the sediment settled at the base without sticking to the sides as would be the case in a basin of sloping wall. The basin need not necessarily be exactly of the same size. Any size approaching to the above will do. The volume of the water in the basin was made upto 10 cm. height and allowed to stand for 24 hours. Due to a large volume of water most of the clay was syphoned off in the first operation of syphoning after 24 hours. For subsequent syphoning the volume was made up to 5 cm. height and the period allowed for standing was four hours. In three to four such washings the supernatant liquid became clear. The residue in the basin was dried and weighed as silt. Having determined sand and silt by weights the clay was estimated by difference.

The results obtained by these methods are given in the following table. For the sake of comparison the data obtained by Puri's method are also given in the same table together with

Table showing the mechanical constituents of soils, their saturation capacities and moisture equivalents

	Puri's Method			Beaker-basin Method			Beaker Method				Saturation capacity	Moisture equivalent
	Sand	Silt	Clay	Sand	Silt	Clay	Sand	Silt	Clay	Total		
1. Tabiji soil ..	88·31	6·65	5·04	92·2	7·4	2·4	90·0	7·3	1·8	99·1	19·7	5·00
2. Delhi ..	76·91	12·76	10·33	73·8	19·1	7·1	72·2	20·1	7·3	99·6	36·0	11·83
3. Kangra ..	59·63	28·82	11·55	59·5	34·8	5·7	60·9	35·8	3·6	100·3	35·5	20·17
4. Samalkot ..	58·51	16·61	24·88	65·9	23·4	10·7	64·2	25·0	10·6	99·8	43·6	20·17
5. Taliparamba	44·30	26·11	29·59	52·1	31·3	16·6	51·6	32·2	16·3	100·1	42·2	32·85
6. Coimbatore	61·59	6·74	31·67	67·2	20·0	12·8	67·4	19·6	11·8	98·8	34·5	18·40
7. Ranchi ..	36·71	21·07	42·22	60·2	31·7	8·1	60·4	32·4	8·8	101·6	32·8	15·60
8. Hagari ..	36·56	19·49	43·95	39·6	32·5	27·9	39·3	38·4	22·3	100·0	44·0	37·05
9. Chinsura ..	2·63	48·76	50·61	18·7	62·8	18·5	20·7	64·9	14·8	100·4	43·0	28·78
10. Akola ..	12·37	29·89	57·74	39·6	40·4	20·0	36·7	47·9	16·5	101·1	47·1	36·31
11. Labhandi ..	14·15	25·18	60·07	34·6	48·6	16·8	36·1	47·6	17·8	101·5	43·6	31·97
12. Padegaon ..	8·89	16·36	74·75	35·2	38·4	26·4	28·8	44.4	26·2	99·4	47·3	36·60



the data of the saturation capacities and moisture-equivalent of the different soils.

From the above data it will be seen that the clay content of the soils obtained by Puri's method is higher than by the other two methods which present almost identical results.

As for the correlationship of the clay content obtained by the beaker or the beaker-basin methods with the saturation capacities or the moisture-equivalents, examination of the graph shows that the curves run nearly parallel to one another, but no relationship of these factors could be established with the clay content obtained by Puri's method.

Thus without under-rating the importance of Puri's method which has merits in its own way, it will be seen that for practical purposes the beaker-basin method is more useful where one has to examine a large number of samples within a short period. It is simple, fool-proof and rapid.

Our thanks are due to Rao Bahadur Dr. B. Viswa Nath, D.SC., F.I.C., C.I.E., and to Dr. S. V. Desai, PH.D., D.SC., for their valuable advice during the course of the work.

* Examination of the figures of 104 soils (Briggs, L. J., and McLane, J. W., *U.S.D.A. Bur. Soils Bul.*, 1907, **45**, 15–16) shows that a distinct co-relationship exists between the clay content and the moisture equivalent.

† Bouyoucose (*Soil Sci.*, **23**, 321) found this period as essential for maximum dispersion. Our own trial with 1, 2, 3, 4, 5, 6, 9, 11 and 24 hours showed that shaking beyond 6 hours had no advantage.

‡ Temperature	Time
20° C.	4 min. 40 sec.
22° C.	4 " 26 "
24° C.	4 " 13 "
26° C.	4 " 1 "
28° C.	3 " 51 "
30° C.	3 " 41 "
32° C.	3 " 31 "
34° C.	3 " 22 "

TECHNICAL PERSONNEL FOR POST-WAR DEVELOPMENT

SIR ARDESHIR DALAL, Member for Planning and Development, in the course of a recent talk to the press on post-war planning, said that the most serious and difficult problem which faced them was the question of trained personnel which was likely to impose well-defined limits to the pace of development. The most essential preliminary step, therefore, was the training of our future scientists, engineers, geologists, doctors, agriculturists, educationists, adminstrators, etc., in the innumerable different jobs for which they would be required. Our educational institutions would have to be expanded and multiplied, and a generous system of scholarships and research studentships would have to be devised for the training of our men both in India and abroad.

Proceeding he said that it was intended to send a large number of such men for training in the near future to the U.K. and the U.S.A. Mr. Sargent, the Educational Advisor to the Government, had been making investigations in both those countries for that purpose, and a detailed scheme would be worked out after his return. One of the most urgent needs of the country was the training of geologists and an increase in the existing personnel of the Geological Department. Our universities should take up the question of geological teaching as an urgent measure. The establishment of a very high-grade technological institute on the lines of the M.I.T. in America, as well as of an All-India Medical Centre, were under consideration.

THE SEVENTH WRIGHT BROTHERS LECTURE

THE Seventh Wright Brothers Lecture was presented before the Institute of Aeronautical Sciences, in the U.S. Chamber of Commerce Auditorium, Washington, D.C., on December 17, 1943, by Mr. W. S. Farren, of the Royal Aircraft Establishment, England. The subject of the lecture was "Research for Aeronautics—Its Planning and Application".

The lecturer in the course of his address dealt with the current problems of aeronautical research and outlined the character of the work of the immediate future. He also drew attention to the changes in the nature of the needed research equipment and organization that have arisen from the maturing of aeronautical development. He stated the aim of research to be twofold, (1) the discovery of how to make better aircraft and (2) to produce a theory firmly supported by experimental evidence. In a way these two aims are substantially identical. The improvement of aircraft design depends to a large extent on a very clear understanding of the nature of fluid flow under different conditions, the elastic and plastic behaviour of the materials of the structure and the production of power for propulsion. In brief, better aircraft are a result of the building-up of rational 'theories firmly supported by experimental evidence'.

The achievements of the past twenty-five years in aeronautical research and their application to aircraft were graphically illustrated by a comparison of the S.E. 5, a single-seat fighter of the first World War, with the modern Spitfire, and the Handley Page O|400 twin-engined heavy bomber with the present-day Lancaster. The substantial reduction in the drag, increase of the power and the improvement of structural design were demonstrated with the help of the available data. The structural developments had been the result of outstanding contributions of research in the field of metal monocoque design, both theoretical and experimental.

The lecturer commented on the better status, to-day, of our knowledge of the stability and control characteristics of aircraft, and on the power plant development of recent years. The problems of the immediate future were pointed out to be concerned chiefly with compressibility effects arising from high speeds at great altitudes. Some new data on the effect of compressibility on drag as influencing the true level speed at various heights were presented. Also the critical character of the wing leading as a function of height was indicated with the help of a diagram.

Mr. Farren emphasised the necessity for close co-ordination among the research workers, the designer, the constructor and the user, in providing information that might be used to improve future designs. From aerodynamics there is the demand for specific information 'covering the whole aeroplane including its propulsion, stability and control'. Structural research should provide schemes of design necessary for precision of form and superficial smoothness, and also discover methods to cope with new strength and stiffness requirements. Again, 'in the future it will be impossible to consider the aeroplane engine and the aeroplane as separate enterprises with conflicting requirements'. The thermo-dynamic problems will be aerodynamic also. Their joint solution will throw up more than enough of the design problems at which the power-plant engineer excels. The aeroplane designer will have to combine the contributions of all the rest into a working proposition. His task will be to provide for pressurized cabins, ice-free surfaces and the large number of new and indispensable aids to control navigation, take-off and landing. The user of aeroplanes also has a responsible role, namely, to encourage the research worker and the engineer in their difficult tasks and to support them to the full with resources in men and material. He has also the duty of contributing operational information that will guide their efforts.

In conclusion, Mr. Farren pointed out that although a great many problems of to-day will require equipment of very large size and complexity, there is still great scope for research workers on a small scale. In any case, all aeronautical research should be a co-operative effort where the assembling and co-ordination of the results of the various groups of workers is of the utmost importance. The solution of each type of problem will naturally be the primary responsibility of groups of specialists, each under a leader. The parts, however, must be welded into a whole and in this welding lies the problem of management for large aircraft establishments. Reviewing the work of the past few years, Mr. Farren felt justified in being perfectly satisfied with the record of achievement and optimistically believed in the complete success of the present effort 'in which the share of research is to provide information by which aircraft and their equipment can be steadily improved and used to greater effect'.

THE INDIAN SCIENTIFIC MISSION

AT the invitation of His Majesty's Government, a Scientific Mission consisting of seven Indian scientists are expected to proceed to England during the first week of October. Sir S. S. Bhatnagar, Sir J. C. Ghosh, Col. S. L. Bhatia, Dr. Nazir Ahmad, Prof. M. N. Saha, Prof. J. N. Mukherjee and Prof. S. K. Mitra constitute the delegation. The Mission will also visit the United States and possibly the Dominion of Canada.

The principal object of the Mission will be to establish contacts with the scientists of allied nations and "to plan arrangements for collaboration and exchange".

LETTERS TO THE EDITOR

A NEW METHOD FOR DETERMINING THE ELASTIC CONSTANTS OF CRYSTALS

In the well-known work of Voigt,[1] the elastic constants of crystals were determined by static methods. Recently Bergmann and others,[2] Atanasoff and Hart[3] and Suryanarayana[4] have used for this purpose certain dynamical methods employing high frequencies. We have now developed a slightly different and highly useful method based on the transmission of ultrasonic waves through crystal plates.

A suitably cut and silvered quartz or tourmaline wedge of a small angle is used in a high frequency circuit in the usual manner as a source of continuously varying ultrasonic frequencies. The oscillations of the wedge are made to pass through a crystal plate and thence into a liquid like CCl_4. The waves thus set up in the liquid are used to produce a Debye-Sears diffraction pattern. The intensity of the diffraction pattern will be a maximum when the sound wave has the maximum strength and this occurs for frequencies which are transmitted preferentially through the crystal plate. The lowest of them is related to the effective elastic constant c'_{33} by the relation $\nu = \frac{1}{2d}\sqrt{\frac{c_{33}'}{\rho}}$ where d and ρ are the thickness and the density of the crystal respectively. Knowing the thickness and the density and measuring the frequency ν with the help of a wave meter, the effective elastic constant is easily calculated.

In a set of trial experiments on aluminium plates, it has been found that the maxima could be quite definitely located and some test measurements gave the effective elastic constant to be $11 \cdot 8 \times 10^{11}$ dynes per sq. cm., which compares very well with the value $11 \cdot 7 \times 10^{11}$ calculated for this substance from the known values of its Young's modulus and rigidity.

In crystals, a sufficiently large number of plates of known orientation have to be investigated upon in order to obtain the complete set of elastic constants. We are extending this method to such cases and amongst the substances thus studied by us is the important crystal of diamond. The fuller results for this and other substances are being reported elsewhere.

Department of Physics,
Andhra University,
Guntur,
September 13, 1944.

S. Bhagavantam.
J. Bhimasenachar.

1. Voigt, W., *Lehrbuch der Kristallphysic*, 1928. 2. Bergmann, L., *Ultrasonics and their Scientific and Technical Applications*, 1938. 3. Atanasoff, J. V., and Hart, P. J., *Phys. Rev.*, 1941, **59**, 85. 4. Suryanarayana, D., M.Sc. Thesis, Andhra University, 1944.

PHOTO-ELECTRIC ESTIMATION OF NICKEL IN ALLOY STEELS

In the course of our investigations on photo-electric analysis of alloy steels we experienced that the colour involved in the estimation of nickel by Vaughan's[1] method is highly sensitive to light and temperature. This effect was very pronounced in summer, when out of three or four samples analysed simultaneously the colour invariably faded by the time we came to the last.

Detailed investigations have been undertaken to study the effect of reagent concentration on the intensity and stability of the colour involved. From the results obtained the following generalisations may be made:—

(1) Increase in the concentration of dimethyl glyoxime results in increased intensity and diminished stability.

(2) An increase in the concentration of ammonia has practically no effect on the intensity of the colour but has a marked stabilising influence on it.

(3) Increased intensity and diminished stability are caused by lowering the concentration of Iodine.

In the light of the above observations various alterations in the procedure have been tried with a view to stabilise the colour and the following were found to be most satisfactory:—

(1) Using 0·2 per cent. solution of dimethyl glyoxime in 80 per cent. "ammonia" instead of 0·1 per cent. solution in 50 per cent. "ammonia".

(2) Substituting N/15 Iodine for N/10 Iodine.

(3) Effecting the final dilution with 50 per cent. "ammonia" and not with distilled water.

(4) Waiting for at least one minute after the addition of Iodine and for two minutes after treatment with the dimethyl glyoxime reagent.

The last item was found to be quite helpful in obtaining reproducible values for the drum differences. Full details giving further particulars will shortly be published elsewhere. Our thanks are due to the Works Manager, The Tata Iron & Steel Co., for permitting the publication of this note.

Research & Control Laboratory,
The Tata Iron & Steel Co.,
Jamshedpur, G. V. L. N. MURTY.
August 24, 1944. N. B. SEN.

1. Vaughan, E. J., The Institute of Chemistry Lecture on "Further Advances in the Use of the Spekker Photo-Electric Absorptiometer in Metallurgical Analysis," 1942, pp. **3** and 4.

A BROTH CHOLERA VACCINE

IT has become customary to prepare prophylactic vaccines against bacterial infections from growths of organisms on agar. As recently as 1940, the Cholera Advisory Committee of the Indian Research Fund Association[1] recommended that "the (Cholera) vaccine should consist of a suspension of the vibrios obtained by washing off the growth from a 24-hour agar culture with 0·85 per cent. saline solution". This recommendation was in accordance with the practice of the majority of laboratories preparing cholera vaccine in large quantities. The reason for the preference for growths on agar over growths in broth, must be due to the anxiety of workers to obtain their suspensions of organisms as free as possible from extraneous proteins.

The acute shortage of the supplies of agar in the country, brought about by the outbreak of war against Japan, led us to investigate the possibility of preparing an effective cholera vaccine from growths in a liquid medium. The success of this effort needed the fulfilment of two conditions: (1) the availability of a liquid medium as free as possible from proteins and yet yielding good growth of the vibrio, and (2) the development of a reliable method of testing the protective power of the vaccine in experimental animals. In the acid hydrolysate of casein of Mueller and Johnson,[2] we have found an excellent liquid medium for the purpose. It gives a profuse growth of the vibrio, is easy to prepare, does not give biuret reaction, and what is more, costs less than half to prepare than the usual laboratory nutritive broths. We have been able to develop a protection test in white mice which gives repeatable results within narrow limits. Our mouse protection test determines the minimal dose of the vaccine required to protect 50 per cent. of the immunised mice against an infective dose of 10 m.l.d.'s administered intraperitoneally with mucin.[3]

In the several experiments we have performed so far the vaccine prepared from cultures in the liquid medium incubated at 28° C. for seven days, killed and preserved with phenyl mercuric nitrate, 1 mg. per 100 ml., gave a mouse protective dose of 0·00003 ml. Against this, the customary cholera vaccine made from 24-hour agar cultures of the same strain containing 8,000 million organisms per ml., gave a mouse protective dose of 0·0004 ml. Further our vaccine has a low toxicity, as much as 1·5 ml. per mouse (18-20 gm.) produced no deaths. However, we are working to still further detoxicate it by the addition of formalin. 0·8 ml. of agar vaccine killed four out of five mice.

The new cholera vaccine we have described is about ten times as potent as the customary agar culture vaccine, has low toxicity and has the great merit of being easier to prepare in large quantities than the agar culture vaccine.

Haffkine Institute, S. S. SOKHEY.
Bombay, M. K. HABBU.
September 9, 1944.

1. Taylor, J., 'Cholera Research in India, 1934–40, under the Indian Research Fund Association, A Review,' The Job Press, Cawnpore, **1941**, pp. 37–38. 2. Mueller, J. Howard, and Johnson, Everett R., *J. Immunol.*, 1941, **40**, 33–38. 3. Griffitts, James J., *Pub. Health Rep.*, 1942, **57**, 707–10.

URINARY EXCRETION OF SULPHANILYL-BENZAMIDE

IN continuation of our previous work (Bose and Ghosh, 1944)[1] where the toxicity and blood concentration of sulphanilyl-benzamide were studied, the present work was undertaken to find out the amount of urinary excretion of the drug in human volunteers. Along with this, the excretion of sulphanilamide was also studied for comparison.

Four laboratory workers volunteered for the study. Two of them were fed orally with 1 gm. of sulphanilyl-benzamide two hours after their morning meal. The other two volunteers were similarly fed with sulphanilamide. The

Urinary excretion of Sulphanilyl-Benzamide and Sulphanilamide in human beings
Dose of each drug = 1 gm. orally

Name of Drug	Volunteer No.	Sample in hours	Total drug excertion in mg.		Percentage excertion of drug in 3 days		
			As free	As conjugated	Total	Free	Conjugated
Sulphanilyl benzamide	1	24	330·2	157·6	70·4	59·3	40·7
		48	78·7	93·1			
		72	8·7	35·1			
	2	24	446·4	233·2			
		48	52·9	107·9	87·6	57·0	43·0
		72	..	46·2			
Sulphanil-amide	3	24	213·2	240·6			
		48	94·0	107·0	71·5	46·7	53·3
		72	25·2	34·8			
	4	24	256·0	475·6			
		48	74·2	168·4	97·4	34·2	65·8
		72	..	..			

total 24 hours' urine was collected for three successive days, and the excretion of the drugs both as free and conjugated forms was estimated daily according to the modified technique of Marshall and Litchfield (1938).[2] The table gives the result of this investigation.

The observations on the urinary excretion as given in the table amply corroborate the rapid systemic absorption of sulphanilyl-benzamide in man (*cf.* Bose and Ghosh, 1944). The average percentage of the total excretion of the drug as apparent from the table was 79 per cent. in 72 hours, which indicate a fair amount of absorption and a moderately rapid excretion. Moreover, it is being found that the excretion of the drug is more as free (58 per cent.) than as conjugated from (42 per cent.). But in the case of sulphanilamide the reverse is being observed. Considering the excretion of sulphanil-benzamide more in the free state it is considered to be of interest to study the effect of this drug in different urinary infections.

The compound being a benzoyl derivative, it would also be worthwhile to study the excretion of hippuric acid, which might give a clue to the possible nature of its breakdown in the system. Work is already in progress.

A. N. Bose.
J. K. Ghosh.

Bengal Immunity Research Laboratory,
August 26, 1944.

1. Bose, A. N., and Ghosh, J. K., *Ind. Jour. Med. Res.*, 1944, **32**, 61. 2. Marshall, E. K., Jr., and Litchfield, S. T., Jr., *Science*, 1938, **88**, 85.

ESTIMATION OF ADRENALINE BY VAN SLYKE MANOMETRIC TECHNIQUE

Pure adrenaline is usually determined by Folin's method as modified by Culhane and Underhill.[1] The significance of the observations of Barker, Eastland and Evers[2] that ascorbic acid as present in suprarenal gland interferes in the oxidation of the catechol grouping as present in the adrenaline molecule, is now obsolete as most of commercial adrenaline is being produced synthetically and as such free from ascorbic acid. As Folin's method is virtually dependent on the oxidation of catechol part by the phenol reagent, it was thought that the same phenomenon may happen in presence of nitrous acid with the liberation of nitrogen gas (*cf.* Carter and Dickman[3]). The latter may then be an easy measure in the estimation of an adrenaline solution according to the equation:

$$3\,CH_3NH\cdot CH_2\cdot CHOH\cdot C_6H_3\begin{cases}OH\\OH\end{cases} + 2\,HNO_2 \rightarrow N_2 + 4H_2O + \text{Oxidised Adrenaline};$$

or, 1 gm. of adrenaline being equivalent to 51 mg. of nitrogen.

On this basis 0·1 per cent. solution of pure adrenaline hydrochloride was treated with nitrous acid in Van Slyke micro-apparatus by the customary method as followed in usual Van Slyke amino nitrogen estimation. The acid reacted vigorously with the adrenaline solution with evolution of gas which was collected, washed with alkaline permanganate and the volume of residual gas left behind, was

noted. A control without addition of adrenaline was also made in each experiment. The difference in the two readings at N.T.P. gave the amount of nitrogen gas formed during the reaction. From this the weights as recorded in the table below, were calculated out:—

Pure Adrenaline—0·1 per cent. solution.
Time of Reaction—40 minutes.
Period of Absorption—30 minutes.

Expt.	Adrenaline		Nitrogen in mg.		Percentage of error
	c.c.	mg.	found	calculated	
1	1	1	0·0523	0·051	2·54
2	2	2	0·1046	0·102	2·55
3	3	3	0·1576	0·153	3·0

From the table it seems that the above reaction between nitrous acid with adrenaline solution (0·1 per cent.) is practically quantitative. The reaction is being further studied for finding out an easy process of assaying liquor adrenalini hydrochloridi which is also a 0·1 per cent. solution of pure adrenaline.

Bengal Immunity Research Laboratory, Calcutta,
September 6, 1944.
U. P. Basu.
N. Ray.

1. *Analyst*, 1932, **57**, 696. 2. *Biochem. J.*, 1932, **26**, 2129. 3. *J. Biol. Chem.*, 1943, **149**, 571.

ANTIOXIDANTS FOR SHARK LIVER OIL

The present investigation is primarily concerned with increasing the storage life of Travancore shark liver oils by addition of antioxidants. Antioxidant properties of 2-O-(O-tri-acetyl)-galloyl phloroglucinaldehyde, gallic acid, and hydroquinone have been studied and the results are given in the table below. The peroxide values were determined by Wheeler's titrimetric method (1932) suitably modified for our requirements. The results are expressed as milli-equivalents of peroxides per kg. of oil.

TABLE I
Effect of different antioxidants on rancidity development in shark liver oil

2-O-(O-triacetyl) galloyl-phloroglucinaldehyde (0·067%)			Hydroquinone (0·086%)			Gallic acid (0·069%)		
Time in days	Uninhibited	Inhibited	Time in days	Uninhibited	Inhibited	Time in days	Uninhibited	Inhibited
0	7·0	7·1	0	16·3	15·3	0	8·5	6·4
2	36·8	11·0	2	33·2	15·4	2	29 8	10·8
4	270·4	12·1	4	202·1	15·4	4	46·3	12·6
5	332·1	12·2	6	235·4	15·4	6	69·8	24·1
7	537·8	16·7	10	565·0	21·6	12	419·7	43·0
9	564·6	16·0						

It will be seen that 2-O-(O-triacetyl)-galloyl phloroglucinaldehyde is far more effective than gallic acid and fairly comparable in its activity with hydroquinone.

Some of the other chemical antioxidants which have been tried by us include O-p-nitrobenzyl-6-nitrovanillinic acid, 3-isovanillylidine-7-methoxychromanone and p-acetoxycinnamonyl phloroglucinaldehyde, nearly all of which furnished indifferent results. The 'inhibitol' concentrates of a few oil-meal extracts were examined for their antioxidant activity and of these the seeds of *Mucuna pruriens* furnished an extract of mild antioxidant character. Further work on the examination of the antioxidant properties of various vegetable oils, oil-meal extracts, and inorganic and organic compounds is in progress.

Dept. of Applied Chemistry,
University of Travancore,
Trivandrum,
July 18, 1944.
P. V. Nair.
T. A. Ramakrishnan.

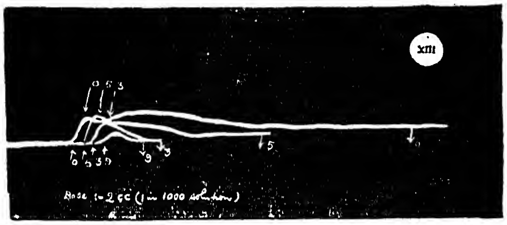
1. Wheeler, D. H., *Oil and Soap*, 1932, **9**, 39

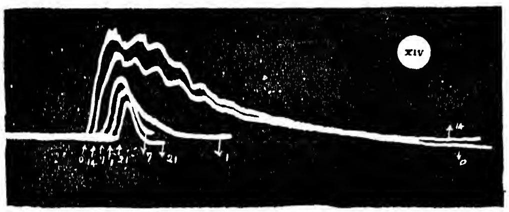
SYMPATHOMIMETICS OF THE NAPHTHALENE GROUP

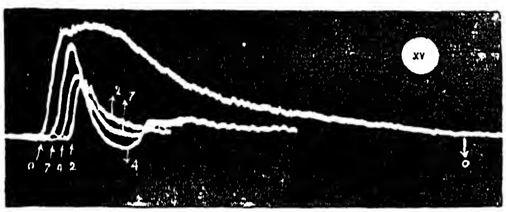
As early as a quarter of a century ago, Madinaveitia[1] reported that the mere substitution of the naphthalene ring in place of the customary benzene nucleus of the familiar sympathomimetics resulted in an augmentation of activity by over forty times. However, the above report was based on the comparison only of a single pair of analogous compounds belonging to the benzene and naphthalene series which possess the accepted structures for sympathomimecity. Although a few amino-ethane derivatives of naphthalene have been reported in literature as probable sympathomimetics from time to time by other workers,[2] no effort has yet been made by any of them either to duplicate Madinaveitia's results or to explore the interesting possibilities held out by his highly significant observation by systematic synthesis and study of aminoethane derivatives of poly- and hetero-cyclic ring systems. An essay in this direction recently made by us consisted in the biological examination of a collection of twenty-one compounds,[3] severally derived from the naphthalene, acenaphthene, phenanthrene and isoquinoline nuclei and possessing the requisite structures necessary for sympathomimetic activity.

The results obtained indicated that an intensive search for possibly promising sympathomimetics has to be made particularly in the naphthalene series: these results as well as the experimental technique adopted have already been communicated.[4] Meanwhile, such of the naphthalenic compounds which showed activity in the earlier study have been subjected to re-examination in respect of their pressor activity in the spinal cat, using tyramine hydrochloride (Serial No. 0) as the control. The compounds now studied are the hydrochlorides of β, β-1:1′-dinaphthyl, β-hydroxy ethylamine (No. 1), β, 2-naphthyl, β-hydroxy ethylamine (No. 2), ω-amino, β-acetonaphthone (No. 3), β-1-naphthyl, β-hydroxy

ethylamine (No. 4), ω-amino, α-acetonaphthone (No. 5), β, 1-naphthyl ethylamine (No. 7), 4-hydroxy, ω-aminoacetonaphthone (No. 9), N, N′-trimethylene *bis*-tyramine (No. 14) and 4-hydroxy naphthyl ethylamine (No. 21). These compounds were divided into convenient groups which were each compared with tyramine in the same animal. The results obtained are embodied in the kymograph tracings of the blood-pressure, entitled graphs XIII-XV.







The dosage consisted of 1 c.c. of a one-in-thousand solution of each of the drugs, corresponding to one mg. of the hydrochlorides, in two of the experiments (Graphs XIV and XV). The administration of doses of 2 c.c. in one experiment gave rise to the Graph XIII.

The present set of graphs serve to reveal the active pressor amines which appear to merit further detailed study. These are β, β-1:1′-dinaphthyl, β-hydroxy ethylamine (No. 1), β, 2- and β, 1-naphthyl, β-hydroxy ethylamines (Nos. 2 and 4), ω-amino- α-acetonaphthone (No. 5), β, 1-naphthyl ethylamine (No. 7) and N, N′-trimethylene *bis*-tyramine (No. 14). Whether any of the six aforementioned compounds is likely to find a place in medicine will be settled by their complete pharmacological examinations now in progress

Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore, S. Rajagopalan.
The Research Unit,
Medical College,
Madras, K. Venkatachalam.
September 12, 1944.

1. Madinaveitia, *Bull. Soc. Chim.*, 1919, **25**, 601; *Annal. Fis. Quim.*, 1920, **18**, 66. 2. Windaus, *Ber.*, 1917, **50**, 1120; Meyer *et al.*, *Ibid.*, 1922, **55**, 1855; Day and Collabrorators, *J. Organic Chem.*, 1940, **5**, 512; 1941, **6**, 384. 3. Rajagopalan, *J. Indian Chem. Soc.*, 1940, **17**, 567; *Proc. Indian Acad. Sci.*, 1941, **13**, 566; 1941, **14**, 126; 1944, **20**, 107. 4. —, and Venkatachalam, *Proc. Indian Acad. Sci.*, 1944, **20**, in press.

FATTY OIL FROM THE SEEDS OF *MAPPIA FOETIDA* (N.O.: Olacaceae)

The fruit of *Mappia foetida* (Marathi: *Kalgur; Ghamera*) was collected for this investigation from the Dajipur forests, about forty miles south-west of Kolhapur, in the Western Ghats. It is a small ellipsoidal fruit resembling *Jambul* fruit in colour and in appearance and even in taste. The seed is enclosed in a stony-hard shell, is uncovered and yellowish white in colour.

The seeds of the dry ripe fruit were crushed and the oil was extracted with benzene in a soxhlet. The solvent was then removed by distillation, the last traces of it being removed under vacuum. The oil is reddish yellow and has a slight fluorescein. On examination it gave the following physical and chemical constants:—Yield, 48 per cent.; specific gravity at 27° C., 0·9319; refractive index at 27°, 1·4781, acid number 3·7; saponification value, 185·4; iodine value (Wiji's method), 45·6; Reichert-Meissel value, 0·68; Polenske number, 0·41; acetyl value, 5·77; unsaponifiable matter, 0·81 per cent.

Chemistry Department,
Rajaram College, M. D. Nadkarni.
Kolhapur, J. W. Airan.
July 29, 1944. S. V. Shah.

A PRELIMINARY NOTE ON 'POLYPORIN'

By growing a Polyporus in Czapeck-Dox medium (pH 7) at room temperature (29° to 32° C.), a filtrate through Seitz-filter has been obtained which has been tested to be highly bactericidal. When the filtrate in the concentration of 1 to 20 is poured in a broth culture of *Staphylococcus aureus*, the latter becomes clear in the course of four to five days with a little sediment at the base of the tube. A subculture of the sediment after nine days shows no growth in the broth-culture tube when examined both visually and microscopically.

The animal-experiment of the whole filtrate proved to be completely non-toxic, the animals employed were guinea-pigs with one control in each case. The filtrate has pH value of 5·8 and it retains its potency at 22° to 28° C. (room-temperature) for about a month as far as we have been able to test.

Genetic change is not possible in this group of fungi by application of chemicals or strong doses of ultra-violet, X-ray and radium.[1]

Chemical isolation of the active principle of the filtrate is being attempted. Clinical trials of the crude filtrate on ulcers and surgical abscesses of a few patients have been very

encouraging. Further work on different aspects is actively proceeding.

This work is being kindly financed by the Indian Health Institute and Laboratory, Ltd., Calcutta.

Botanical and Pathological Lab.,
Carmichael Medical College,
Calcutta,
August 23, 1944.

S. R. BOSE.
ANIL C. CHOUDHURY.

1. Bose, S. R., *La Cellule*, 1934, Tome **42** and *J. Ind. Bot. Soc.*, 1938, **17**.

TIP-BURN OF *PIPER BETLE* IN THE CENTRAL PROVINCES

TIP-BURN, a physiological disease of *Piper betle*, has been observed to cause considerable damage to the crop in this Province during the hot and dry months. The disease is characterised at first by wilting of the tissues at the extreme tips or sometimes at the margins, followed later by a browning and death of the tissue (Fig. 1). These dead and brown-coloured patches later turn hard and brittle and are often broken or torn. A part or the whole of a leaf may succumb to this disease. Unlike fungal or bacterial infections the diseased leaves do not drop off but remain attached to the vines in a flaccid condition. Young and immature leaves are more severely affected than the old and mature ones. *Kapuri* variety of pan, whose leaves are of softer and thinner texture, has been observed to be highly susceptible to this disease than *gangeri*, *kakher* and *bangla* varieties with thicker leaves. *Bangla* variety of pan has been observed to be most resistant of all the varieties under observation. It has been further noticed that leaves on the vines affected with foot-rot disease (*Phytophthora parasitica* var. *piperina* Dast.) with poor root system succumb more readily to tip-burn than those on healthy plants.

FIG. 1. Tip-burn of *Piper betle*

The disease is caused by excessive loss of moisture from the leaves due to hot and dry weather conditions which prevail during the months of March to June in this Province. It is first observed towards the end of March or beginning of April and reaches to its maximum severity about the middle of May. The incidence of the disease is not marked after the rains set in. Repeated isolations from the diseased portions have given negative results about the presence of any pathogenic micro-organism.

It has been worked out and experimentally shown that this tip-burn disease could easily be kept in check or its incidence considerably reduced if the *barejas* (pan gardens) are properly shaded at the top, the vines are lowered latest by the second week of March and the garden is kept moist by adequate irrigation during the hot and dry months.

Agricultural Research Institute,
Nagpur,
July 21, 1944.

R. P. ASTHANA.
K. A. MAHMUD.

VERNALISATION OF MUSTARD

IN their note on "Studies on the Physiology of Mustard", published in the June 1944 number of *Current Science*, J. C. Sen Gupta and N. K. Sen have reported their interesting observations on photoperiodic and vernalisation studies with Tori No. 7 and Rai No. 5. The authors observed that Rai No. 5 sown on September 1, 1943, took 46 days to flower, whereas from a sowing of November 15, 1943, flowers were observed in 27 days. On the basis of this observation the authors have concluded that "the vegetative period shortens with lower temperature". But further on in their note, they state that "Rai shows a lengthening of vegetative period with the shortening of the light period and a greater shortening of the vegetative period is observed with increased temperature range and this confirms Sen and Chakravarti's findings (1942)." It is difficult to reconcile these two statements which appear to be directly contradictory. As a matter of fact, it has been our experience that, under otherwise similar cultural conditions, lower temperature invariably lengthens the vegetative period.

The authors observed the effect of prechilling of "soaked unsprouted seeds" of Tori and Rai at 2-4° C. for 10, 20 and 30 days. They state, "Sen and Chakravarti (1942) ...... have reported a clear earliness of flowering in mustard due to presowing low temperature treatments. The results reported here do not confirm their findings ..." In reply, we wish to point out that we have never asserted that all strains of mustard will respond to vernalisation, but we[3] have stated that all the five strains of mustard with which we worked—T 27, C 11, C9, *raya* O|B I and yellow *sarson*—do give a very definite vernalisation response. In the Discussion on Vernalisation[2] held by the I. C. A. R. in December 1939, points strongly

emphasized by one of us were that (i) experimental data must be obtained to find out whether particular strains of a selected crop will or will not respond to vernalisation, (ii) to obtain this information, experiments with different strains of crops should be undertaken in various regions and (iii) the study of the effect of prevailing aftersowing environmental factors of given regions on the life-cycle of both vernalised and untreated seeds is essential to evaluate the practical possibilities of vernalisation for agriculture.

It may well be that Rai No. 5 and Tori No. 7 do not respond to vernalisation but from the experimental work reported by Sen Gupta and Sen no definite conclusion seems to be justified for the following reasons:—

1. The maximum period of chilling used by the authors was only 30 days; a period which at least in the case of five strains of mustard referred to above we have found to induce only incomplete vernalisation. Wide variation in vegetative cycles as reported by the authors for Rai No. 5 and Tori No. 7 is usually one of the characteristics of an incompletely vernalised batch of seeds.

2. The fact that unsprouted soaked seeds were chilled at 2-4° C. for different periods does not in itself ensure that they were properly vernalised. The authors have not given any idea of the conditions of the different batches of seeds after chilling, nor have they described the technique used. To induce effective vernalisation the life-activity of the embryo during the process of chilling must continue. It has been our experience[1,3] that under effective chilling conditions a certain percentage of seeds in every batch under treatment will invariably sprout, and this is a visual indication that the life-activity of the embryos has not been suspended during the period.

3. There is no evidence that the authors have taken into consideration the full implications of their own final remark, a truism to all students of vernalisation work, "that for any conclusion arrived at, after vernalisation studies, the variety and the post-treatment environmental conditions should always be taken into account". For they have formed their conclusions from the data obtained from a single sowing of Rai No. 5 and Tori No. 7 on October 1, 1943.

Vivekananda Laboratory,
Almora, B. SEN.
July 7, 1944. S. C. CHAKRAVARTI.

1. Sen, B., and Chakravarti, S. C., *Indian J. Agric. Sci.*, 1838. 2. —, *Third Meeting Crops and Soils Wing, I.C.A.R.*, 1940. 3. —, and Chakravarti, S. C., *Indian J. Agric. Sci.*, 1942.

SELF- AND CROSS- INCOMPATIBILITY IN SOME DIPLOID SPECIES OF SOLANUM

PAL and Pushkarnath[1] and later Pushkarnath[2] have presented evidence showing that self- and cross-incompatibility in *S. Caldasii* and *S. subtilius* is genetical and is controlled by a series of five oppositional factors. Further studies with these two species and with *S. chacoense** and E.P.C. 143 (an unidentified South American variety obtained from the Empire Potato Expedition, probably belonging to *S. subtilius*), have shown the presence of six additional factors which belong to the same allelomorphic series. The experimental evidence, briefly summarised below, shows that these six factors are distinct from the five reported earlier, thus bringing the total to eleven.

1. Family No. D-29—*S. Caldasii* var. 1 × *S. Caldasii* var. 07.—Crossing tests made with 14 F_1 plants gave four intra-sterile groups of plants, A_1, B_1, C_1, D_1, with 4, 3, 2 and 5 plants respectively, in each group.

2. Family No. D-34—*S. Caldasii* var. 07 × *S. Caldasii* var. 1.—This was the reciprocal of the previous cross and tests made with 15 F_1 plants indicated here also the presence of four intra-sterile groups of plants, W, X, Y and Z, in the proportion of 6, 4, 2 and 3 plants in each group respectively.

Further experiments proved, as was expected, that the A_1 class of family D-29 was identical, with the Y class of family D-34 and B_1 with W, C_1 with X and D_1 with Z. For this reason plants belonging to the classes W, X, Y and Z were eliminated from further tests.

3. Family No. C. 115—*S. Caldasii* var. 01 × E.P.C. 143.—Seventeen F_1 plants tested gave four groups of intra-sterile plants in the proportion of 4, 4, 6 and 3 plants. These groups of plants were designated as E_1, F_1, G_1 and H_1 respectively.

4. Family No. C. 198—*S. chacoense* var. 07 × *S. subtilius* var. V_1.—Out of 20 F_1 plants raised in this family 12 were tested and four intra-sterile groups of plants, I_1, J_1, K_1 and L_1 established with 2, 5, 4 and 1 plants in each of the groups respectively.

The four families referred to above, thus gave a total of 12 intra-sterile groups of plants (A_1 to L_1). Crosses made reciprocally, in all possible combinations, amongst these 12 groups of plants showed that these were cross-compatible, thereby indicating that the constitution of no two groups of plants was identical and that the six varieties used as parents in the above-mentioned series of crosses differed in respect of the pair of sterility factors present.

The genetical constitution of *S. subtilius* var. V_1 (S^1S^3), *S. Caldasii* var. 01 (S^1S^5) and *S. Caldasii* var. 07 (S^2S^4), which have been used in the above crosses, was already established by our previous studies and it was known that these varieties between them carried five sterility factors. The present series of crosses was designed to discover whether any of these factors was present in the other three varieties used in the crosses.

The plants of the 12 intra-sterile groups (A_1 to L_1) when crossed with the ten 'testers' carrying S^1S^2, S^1S^3, S^1S^4, S^1S^5, S^2S^3, S^2S^4, S^2S^5, S^3S^4, S^3S^5 and S^4S^5 combinations of factors gave (with the exception of two doubtful cases) completely cross-compatible reactions. Therefore none of the 12 groups of plants had any of the above combinations of

factors in their constitution. The constitution of the three varieties, *S. Caldasii* var. 1, E.P.C. 143, and *S. chaceoense* var. 07 in respect of the sterility factors is, therefore, represented by S^6S^7, S^8S^9 *and* $S^{10}S^{11}$ respectively and the 12 intra-sterile groups of plants have the following factorial constitution:—

$A1 = S^2\ S^6$	$B_1 = S^2\ S^7$	$C_1 = S^4\ S^6$
$D_1 = S^4\ S^7$	$E1 = S^1\ S^8$	$F_1 = S^1\ S^9$
$G_1 = S^5\ S^8$	$H_1 = S^5\ S^9$	$I1 = S^1\ S^{10}$
$J_1 = S^1\ S^{11}$	$K_1 = S^3\ S^{10}$	$L_1 = S^3\ S^{11}$

Apart from the above eleven factors it is very likely that there are also other '*S*' factors in this allelomorphic series in the diploid *Solanums*. We have already found indications of the presence of some new factors in a sample of potatoes, E.P.C. 142, from the collection made by the Empire Potato Expedition. An exhaustive study is bound to increase their number still further.

The presence of the '*S*' series of allelomorphs has been also discovered in two other species, *S. aracc-papa* and *S. Rybinii*. The behaviour of both these species in crossing tests, however, does not follow the simple mode of inheritance, as outlined in the oppositional factor hypothesis.

S. Rybinii under normal conditions is highly self-incompatible. Twenty-two plants obtained from a natural berry showed irregular behaviour in the crossing tests. The findings of Carson and Howard[3] in this connection are interesting. Crosses of this species have been obtained with S^1S^3 plants of *S. subtilins* and the progenies are under study.

We are grateful to Dr. S. Ramanujam, for helpful suggestions in the course of these investigations.

Imperial Agricultural Research Institute, New Delhi, — B. P. PAL
and
Potato and Wheat Breeding Station, Simla, — PUSHKARNATH.

June 29, 1944

1. Pal, B. P., and Pushkarnath, *Nature*, 1942, **149**, 246. 2. Pushkarnath, *Indian J. Genet. & Plant Breed.*, 1942, **2**, 11. 3. Carson, G. P., and Howard, H. W., *Nature*, 1942, **150**, 290.

EFFECT OF MERCURY ON MICRO-ORGANISMS

Of all the preventive measures,[1,2] suggested in the storage of grains against insects, the easiest and the most striking is the lethal effect of mercury on the eggs of insects commonly found in places where grains are stored. Besides insects, however, fungi and bacteria also infest these storage places, more particularly under wet conditions.

The effect of mercury on some common types of fungi and bacteria has been investigated.

Pure cultures of a few representative fungi (glucose agar media) and bacteria (beef extract media) were taken and mercury was mixed in some tubes, while in others it was kept at one end of the test tube. These tubes of pure cultures of the organisms were kept under mercury vapour for about two weeks at a temperature between 25° to 30° C. The growth of these were in no way affected as compared with the untreated controls. Re-inoculations were then made from the mercury-treated cultures; the growth of the organisms occurred as usual.

Botany Department, Government College, Lahore, — JAGJIVAN SINGH.

June 29, 1944.

1. Dutt, G. R., and Puri, A. N., *The Agricultural Journal of India*, 1929, **24**, Pt. 4. 2. Hem Singh Pruthi and Mohan Singh, *Imperial Council of Agricultural Research Bulletin*, No. 57.

FERTILISATION IN *ISOACHLYA ANISOSPORA* (de BARY) COKER VAR. *INDICA* SAK. et BHAR.

The question of fertilisation in the family Saprolegniaceæ had been the subject of much controversy for a considerably long time. Earlier workers in the field like de Bary,[1] Humphrey[2] and Hartog[3,4,5] held the view that antheridia, though present, were functionless. Trow[6,7] was the first cytological investigator to demonstrate that fertilisation took place in the family Saprolegniaceæ. Since then fertilisation has been shown to occur in various genera, *viz.*, *Achlya*, *Saprolegnia*, *Aphanomyces*, *Brevilegnia*, *Leptolegnia* and *Thraustotheca* Wolf, p. 464).[8] In the genus *Isoachlya* also (Coker),[9] it has been observed that antheridia and oogonia are present, but no cytological evidence as to the fertilisation has yet been reported.

The material for the present study was obtained from a local pond (Saksena and Bhargava)[10] and was fixed in Raper's chromoacetic acid solution. Serial sections were cut 4 μ thick and were then stained with Gram's stain in the usual manner.

Along with the differentiation and maturation of the oospheres the formation of a multinucleate fertilisation tube from each antheridium takes place. Later on the fertilisation tube penetrates the oogonial wall and grows in between the oospheres (Fig. 1, F). When it reaches an oosphere its membrane gets ruptured and a single male nucleus is released into the oosphere. The male nucleus proceeds towards the female nucleus, which is usually located near the centre of the oosphere and the two nuclei come in contact (Fig. 2). The intervening nuclear membranes finally disappear and a fusion nucleus is thus formed. In Fig. 1, the two nucleoli are seen lying side by side in the fusion nucleus. Later on, these nucleoli also fuse.

The present investigation shows that fertilisation takes place in *Isoachlya anisospora* de Bary) Coker var. *indica* Sak. et Bhar. by the discharge of a single male nucleus from the fertilisation tube into the oosphere, the male nucleus subsequently fusing with the female

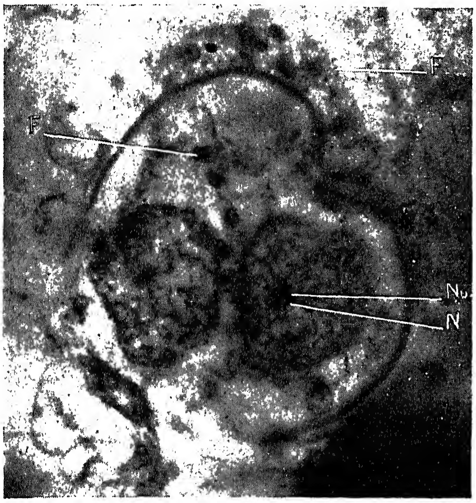


FIG. 1. Photomicrograph of a section of an oogonium of *Isoachlya anisospora* var. *indica* showing a multinucleate antheridium (A) attached to the oogonium. A multinucleate fertilisation tube (F) and an oospore containing a fusion nucleus (N) with two nucleoli (Nu) are also seen. × 1433.

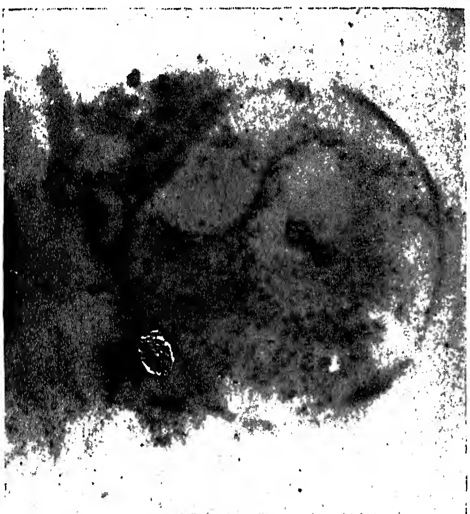


FIG. 2. Photomicrograph of a section of an oosphere containing male and female nuclei lying side by side. × 1433.

one. Belonging to the family Saprolegniaceæ, this is, therefore, another genus and another species in which fertilisation has been demonstrated for the first time.

A fuller account of the process will appear elsewhere.

The work was carried out in the Botany Department of the Allahabad University under the guidance of Dr. R. K. Saksena to whom the author wishes to express his sincere gratitude.

Birla College,
Pilani (Jaipur State),
July 12, 1944. K. S. BHARGAVA.

1. Bary, A. de, *Comparative Morphology and Biology of Fungi*, 1887. 2. Humphrey, J. E., *Trans. Amer. Phil. Soc.*, 1893, **17**, 63–148. 3. Hartog, M. M., *Trans Roy. Irish Acad.*, 1895, **30**, 649–708. 4. —, *Bot. Gaz*, 1896, **39**, 98. 5. —, *Ann. Bot.*, 1899, **13**, 447. 6. Trow, A. H., *Ibid.*, 1899, **13**, 131–79. 7. —, *Ibid.*, 1904, **18**, 541–69. 8. Wolf, F. T., *Mycologia*, 1938, **30**, 456–67. 9. Coker, W. C., *The Saprolegniaceae, with notes on other watermolds*, 1923. 10. Saksena, R. K., and Bhargava, K. S., *Curr. Sci.*, 1944, **13**, 79.

FINAL PELAGIC LARVA OF *SQUILLA HIEROGLYPHICA* KEMP.

A NUMBER of species of stomatopod larvæ from the Madras plankton have been recently correlated with their specific adults by rearing the final pelagic stage through metamorphosis and subsequent growth in the laboratory.[1,2] The larval stages of several species that have not hitherto been recorded from the Madras coast are also occasionally caught in the townet, showing that all the species of adult stomatopods occurring in any particular locality are not yet known to us.

A single larva in the final pelagic stage was obtained from the tow-net collection on March 5. 1943, and this on metamorphosis was found to belong to the rare Indo-Pacific species *Squilla hieroglyphica* Kemp. The following is a brief account of this larva.

Total length including rostrum = 30 mm.; length of rostrum = 4 mm.; median length of carapace, excluding rostrum = 11·5 mm.; breadth of carapace immediately behind antero-lateral spines = 3·0 mm.; breadth of carapace at base of postero-lateral spines = 5·0 mm.; length of antero-lateral spine = 0·8 mm.; length of zoea spine = 0·6 mm.; length of postero-lateral spine = 3·4 mm.; length of raptorial propodus = 3·9 mm.; length of telson = 3·2 mm.; breadth of telson = 3·0 mm.

The carapace is long and broad, posteriorly covering the proximal half of the seventh thoracic segment. In the mid-dorsal line there is an incomplete longitudinal carina which does not extend upto the conical prominence on which the zoea spine is situated (Fig. 1 *a*). Along the lateral margin there are 8 + 3 spinules, of which the first is situated near the base of the antero-lateral spine. The distance between the first and second spinules is about three times that between the second and third. The eighth spinule is directed outwards and the distance between it and the ninth is only slightly over that between ninth and tenth. The rostrum is long and slender and without ventral spinules. The postero-lateral spine has a ventral spinule at about one-fourth its length from base, and has its tip reaching the level of the hind margin of the second abdominal segment. The tip of rostrum is superior to the tip of antennular peduncle. The eye stalk is a trifle shorter than the eye proper. The

raptorial propodus has three stout spines and a row of pectinations. The dactylus has only the terminal tooth. Abdominal segments are broader than long; sixth with a pair of submedian dorsal spines. Lateral spines of telson short; denticles—one lateral, 11 intermediate, and 18 submedians on each side (Fig. 1 *b*). Uropod reaches almost to the base of intermediate spine; basal segment of exopod with three free spines; outer spine of ventral prolongation about one-third the length of the inner, the tip of which projects beyond that of endopod.

Hands of the third, fourth and fifth thoracic limbs are coloured conspicuously yellowish red.

The larva was kept alive in a glass dish of clean sea water, and overnight it metamorphosed into a post-larva, 17 mm. long, having

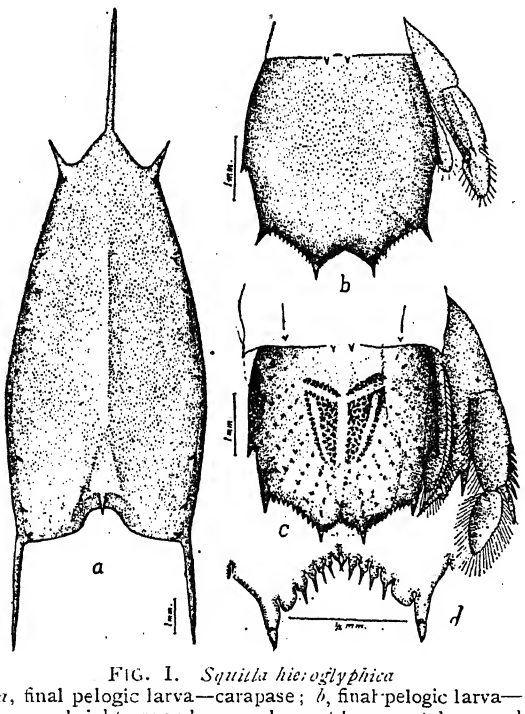


FIG. I. *Squilla hieroglyphica*

a, final pelogic larva—carapase; *b*, final pelogic larva—telson and right urapod; *c*, early post-larvas—telson and right urapod; *d*, early post-larva—submedian area of telson.

undergone a complete moult. Fed regularly, it lived in the aquarium for 8 days and then died while undergoing the first post-larval moult.

In spite of its small size the specimen agrees remarkably well with Kemp's account (1913)[3] of *S. hieroglyphica*. The characteristic colouration on the telson, which according to Kemp is unlike any other species, is quite well marked in the young post-larva. On either side of the median carina of telson there are two longitudinal bands of dark chromatophores, the inner one very much broader than the outer, with which it is connected proximally. Close to but distinct from the base of these bands, on either side, is an obliquely placed narrow band which is even darker in colour (Fig. 1 *c*). There are five dark spots on the eye stalk, three of them arranged in the form of a triangle, while the rest are placed close to the cornea towards its outer aspect, on either side. The submedian spines of telson are terminally articulated and there are six submedian denticles on each side (Fig. 1 *d*).

S. hieroglyphica is a rare stomatopod, so far known only from two specimens, the type from an unknown locality (Kemp, 1913), and the second from the Philippines (Kemp, 1915). The present one from the Madras coast considerably extends the range of distribution of this rare species. It is interesting to note in this connection that Schmitt (1940)[4] records a closely related species, *S. hildebrandi* from the Panama Canal zone.

University Zoolozy Laboratory,
Madras, K. H. ALIKUNHI.
Department of Natural Science,
Maharaja's College,
Ernakulam,
August 24, 1944.

1. Alikunhi and Aiyar, *Curr. Sci.*, 1942, **11**, 2; 1943, **12**, 3. 2. Alikunhi, K. H., *Ibid.*, 1944, **13**, 1. 3. Kemp, S., *Mem. Ind. Mus.*, 1913, 4; *Philip. Jour. Sci.* (D), 1915, 10, 4. Schmitt, W. L., *Allan Hancock Pacific Exped.*, 1940, **5**, 4.

OCCURRENCE OF A STAUROMEDUSA ON THE INDIAN COAST

ACCORDING to Mayer[1] and many other students of Scyphozoa, the Stauromedusæ are found only in the Arctic and Antarctic regions and in the cold seas; owing to their absence from the tropics the group is often cited as a very noteworthy example of bipolarity in distribution.[2] It is, therefore, of unusual interest to record the occurrence of a Lucernarian from the Indian coast at the Krusadai Island in the Gulf of Manaar.

In recent years students from colleges at Madras and Trivandrum have made collections of Lucernarians during their study tours at Krusadai. I have been able to examine a number of specimens from these collections. As a detailed account may have to wait till normal publication facilities are again available the significant facts may here be recorded.

The Lucernarian occurring at Krusadai is one of the Eleutherocarpidæ with a well-developed but short stalk and eight marginal lobes, each of which bears a cluster of knobbed tentacles. The general appearance is similar to that of *Lucernaria* usually figured in text-books and differing from *Haliclystus* in the absence of marginal anchors. The short peduncle is single-chambered and the inter-radial septa projecting into this chamber are devoid of longitudinal muscles. There are well-developed glandular pads on the clusters of tentacles. Owing to these and other characters the species comes under the genus *Lucernariopsis* belonging to the sub-family *Kishinouyiinæ*, adopting the scheme of classification proposed by Carlgren.[3] This genus is now known from three species, *L. campanulata* of the coasts of Europe and the Mediterranean (which is the common European Lucernaria), *L. capensis*

from South Africa described by Carlgren[4] and *L. vanhöffeni*, described by Browne[5] from the Antarctic. The genus *Lucernaria* includes only species known from the colder regions of the Atlantic. Both these genera are unrepresented in Japanese coasts where a number of other interesting Stauromedusæ are known.[6] Now that this rare group of Coelenterates is known from the Krusadai it is hoped that a more intensive search will be made for Lucernarians in other coastal regions of India. It would appear that the group is not so strictly bipolar as is commonly assumed. The possibility of these medusæ being brought to the tropical zone by means of cold currents from the south also needs careful study.

University Zoology
Research Laboratory,
Madras, N. KESAVA PANIKKAR.
August 15, 1944.

1. Mayer, A. G., *Medusæ of the World*, 1910, **3**, 500. 2. Ekman, S., *Tiergeographie des Meeres*, *Leipzig*, 1935, **330**. 3. Carlgren, O., *K. Svenska Vet. Akad. Handl. Ser. III*, 1935, **15**, 1–24. 4. —, *K. Fysiograph. Sälls. Lund. Forh.*, 1939, **Bd. 8**, 139–44. 5. Browne, E. T., *Coelenterata V. Medusae. Rep. Nat. Antarct. Expd. Nat. Hist.*, 1910, **5**, 1–62. 6. Uchida, T., *Jap. Journ. Zool. Tokyo*, 1929, **2**, 103–89.

THE FOOD OF RIBBON-FISH *TRICHIURUS*. Spp.*

THE Ribbon fishes, commonly known as "Thalayan" on the west-coast of our Presidency, are ribbon-like in appearance possessed of an elongated body, which is compressed from side to side. These fishes afford a good fishery from September to end of November, after which period catches are very poor upto end of March.

The study on the food of the Ribbon-fish was based upon a systematic examination of the stomach contents of 281 specimens of *T. savala* (Cuv. and Val.), 208 specimens of *T. haumela* (Forsk) and 2 specimens of *T. muticus* (Gray). This has established the fact that Ribbon-fishes are mainly carnivorous in their feeding habits. Besides, it has been possible to infer from the many observations made, that their appetite is something insatiable. Several specimens when examined showed the stomach unusually distended and gorged with foodmaterials in different stages of the digestive process.

Coupled with the voracity for eating, these carnivorous fishes exhibit a total lack of choice as regards their food. So indiscrinminate is their feeding habit, that sometimes, their abundance may have some adverse effect on other fisheries. For instance, the samples of *T. savala*, examined on 10th September 1943, revealed the stomach to be literally clogged with macerated fish-eggs, which feature would very likely hit other fisheries.

Prawns and White-baits constitute their favourite food, for these were invariably found in all stomachs. Ribbon-fishes are so partial to prawns and white-baits that they pursue them for long distances. Ribbon-fishes since they follow shoals of white-baits and prawns have been profitably hauled by fishermen in those localities where prawns and white-baits abound. Besides, statistics point out that there is some relation between the fishery of Ribbon-fish and white-bait, for when the white-bait fishery is poor, than that of Ribbon-fish is also comparatively little.

The other items of food found in their stomach are given below:—

1. Sardine (*Sardinella fimbriata*).
2. Silverbelly (*Leiognathus splendens*, *L. bindus*).
3. Sole (*Cynoglossus semifasciatus*).
4. Big-jawed Jumper (*Lactarius Lactarius*).
5. Rainbow-sardine (*Dussumieria hasselti*).
6. Anchovy (*Engraulis mystax*, *E. dussumieri*).
7. Glass-fish (*Ambassis dayi*).
8. Grunter (*Pristipoma* spp.).
9. Horse-Mackerel (*Caranx*. spp.).
10. White Sardine (*Kowala thoracata*).
11. Jew Fish (*Sciaena*. spp.).
12. Fish Larvæ, Eggs, Sand-grains.

Marine Biological Station,
West-Hill,
March 12, 1944. R. S. VENKATARAMAN.

* Published with the kind permission of the Director of Industries and Commerce, Chepauk, Madras.

ACCLIMATISATION OF SALT-WATER MULLET *MUGIL SEHELI* TO FRESH WATER†

DEVANESEN AND CHACKO* have shown how fry of Mulletts—*Mugil troschelii* and *M. waigiensis* taken from the sea—can be accumulated to the freshwater conditions at Krusadai Biological Station. Commenting on this note Hora has pointed out the great practical importance of culture of these fishes in the areas adjoining the sea-shore. This note embodies the results of acclimatisation of a common Mullet along the West Coast—*Mugil seheli*.

South of the West-Hill Marine Biological Station is a stream which is connected with the sea during high tide but is cut off from it by a sand bar during low tide. It is noticed that during low tide *Mugil seheli* are trapped in the stream. The fishes were collected from this locality and kept in a glass tank filled with salt-water. The water in the tank was kept constantly aerated by means of a simple aeration apparatus. Gradually the salinity of the water in the tank was reduced by the admixture of fresh well water for a period of 12 days when the tank was filled entirely with fresh-water. The fishes were fed on fresh plankton—Copepod, Leucifer, Sagitta, etc. It was observed that the fishes were not in the least affected by the changes in salinity. They continued to thrive very well in fresh-water. There is every reason to believe that the freshwater fishery resources can be made more productive by stocking them with *Mugil seheli*.

Marine Biological Station,
West-Hill,
December 10, 1943. R. S. VENKATARAMAN.

† Published with the kind permission of the Director of Indurstry and Commerce, Madras.

* Devanesen D. W., and Chacko P. I., *Pro.. Nat. Inst Sci.*, **1943 19**, No. 2.

REVIEWS

Physics and Philosophy. By Sir James Jeans. (Cambridge University Press), 1942. Pp. vii + 222. Price 8/6.

The human mind has generally attempted to interpret observations in terms of simple and fundamental concepts. The growth of experimental enquiry that has been the root of scientific progress has proceeded side by side with speculation in the formulation of theories. Such theories have in general attempted pictorial representations of the phenomena that have unfolded themselves to the experimenter. Recent progress in physics has seriously interfered with the facility with which such representation had been attempted in the past. Space-time and the wavicle have as yet refused to be pictured except by doubtful analogies. The law of casualty, long inherent in the human mind, has been attacked. Finally, whereas the experimentalist goes on merrily with what he regards as a concrete and objective world, the philosophical scientist has revived the great question as to what exactly lies beyond the observers' mind and his senses. What do we mean by reality and how do we arrive at a concept of it?

Sir James Jeans is one of those who have been seeking to explore the philosophical implications of the latest theories in physics, and the book under review is one of the many that have recently been written on the subject. A study of some of these books, such as have been written by Eddington, Jeans and Dingle, shows that the authors hardly see eye to eye on many important matters, which result can only be explained by the nature of the subject.

The book starts with a disquisition on the nature of physical knowledge and proceeds with a short review of the progress of philosophical thought during the ancient, medieval, the renaissance and later periods. This is followed by a discussion on 'sources of knowledge' or the ways of acquiring a knowledge of the external world, including a critical review of the views of writers such as Plato, Thales, Decartes, Spinoza, Leibniz, Kant and others leading up to the modern philosophers. The growth of mathematical and physical concepts, particularly those relating to space and time is then described. Chapter three opens with a consideration of the precision of the language and terminology employed in philosophy and in science respectively and the relative exactness of the connotations of the terms employed in them. The author explains how doubts and disputes would arise from uncertain connotations and considers the different meanings that a statement may convey to a physicist and a philosopher.

This is followed by a study of the progress of mechanistic views of the world and its phenomena as developed by the earlier great physicists, and the shock these views received through the work of Planck, Einstein, Heisenberg, Dirac and others. These later contributions are then explained and their reaction on the classical ideas discussed in two chapters. The last chapter constitutes a philosophical enquiry into the problems considered so far. There is first a search for a philosoph[ical] approach to the puzzling experiences of [the] physicist, expressible by fairly satisfact[ory] mathematical symbolism, but eluding attem[pts] at forming consistent pictures or models [to] describe the phenomenal world, as in the ca[se] of the particle-wave character of matter [and] radiation and the four-dimensional space-ti[me]. The author then proceeds to say 'we have se[en] that efforts to discover the true nature [of] reality are necessarily doomed to failure' [and] suggests that progress lies in what he ter[ms] 'probable reasoning' and the 'simplicity pos[tu]late' which he then elaborates. There is th[en] a short discussion on reality and appear[ance] and on mind and matter. The book clo[ses] with an analysis of the arguments for det[er]minism and indeterminism (free-will), lead[ing] up to his conclusion that 'modern philoso[phy] also seems to have come to the conclusion th[at] there is no real alternative to determinism'.

A. VENKAT RAO TELAN[G]

Physics and Radio. By M. Nelkon. (Edw[ard] Arnold & Co., London), 1944. Pp. 388. Price 8/6.

This book is an attempt to present [the] fundamental physical principles of Radio [to] those who desire to become radio technici[ans] and to the average science student quali[fied] to enter a collegiate institution in India [or] elsewhere. It is divided into twenty-[...] chapters dealing with the electrical struct[ure] of matter, D.C. theory, electrolysis, elect[ro]statics, magnetism, electromagnetism, A.C. [cir]cuit theory, and the valve as an oscillat[or,] voltage amplifier, power amplifier, etc. The[re] is a chapter on sound which contains an e[le]mentary discussion on aerials and a chap[ter] on light giving some description of the i[ono]sphere. The cathode-ray oscillograph co[mes] up for detailed treatment suitable for [the] readers to whom it is addressed in a separ[ate] chapter. There are suitable numerical exa[m]ples and questions at the end of each chap[ter.] The printing, get-up, illustrations, etc., [are] good. The treatment of the subject-matte[r is] quite good in every chapter and the arrang[e]ment of the matter is quite logical and sys[te]matic. A knowledge of mathematics of [the] matriculation standard is adequate for follo[w]ing the subject-matter of the book.

In the opinion of the reviewer, it is a b[it] biassed towards physics. There is not [the] necessary emphasis on the technical and pra[c]tical side of Radio. This is not very desir[able] in a book which goes into the hands of [the] technician. The necessary theory has alw[ays] to be linked with the day-to-day proble[ms] he has to handle. Consequently, the b[ook] cannot be regarded as a very useful one [for] Radio Mechanics and Wireless Operators. Su[ch] persons may find it very useful for supp[le]mentary reading.

Unfortunately, in our country, the physics [of] radio comes for very little attention in [our] schools and colleges. Some chapters of [the] book serve the most useful purpose of fill[ing] this gap and are to be very strongly reco[m-]

mended to pass B.Sc. students doing physics as one of their subjects and to B.Sc. students doing physics as a subsidiary subject. Part of the book is also certainly useful to electrical engineering diploma students who are required to know some of the basic principles of Radio.

S. V. CHANDRASHEKHAR AIYA.

The Indian Central Cotton Committee Report, 1943

The twenty-second Annual Report of the Indian Central Cotton Committee for the year ending 31st August 1943, records another year of its useful work for the benefit of the grower and the consumer of raw cotton. The most outstanding event in the year was its declaration of policy which should be followed during the period of war. It stressed the need for a balanced producion of the various types of cotton grown in the country. The annual exports to Japan on an average used to be 1·5 million bales, consisting mostly of the short-staple varieties and the whole of this was a surplus without a market. The Committee requested the Government of India to urge on all the Provinces and States growing short- and fair-staple cotton to reduce forthwith the acreage by at least 50 per cent.; and to grow food-crops instead as adequate stocks or reserves of the produce of the latter will be a vital national asset for some years to come. This was followed by the Government of India creating a special "cotton fund" from the proceeds of the levy of an additional duty of one anna per pound on all imported cotton to finance measures for assisting the grower of certain types of cotton which used to be exported in large quantities to the Far East. At the instance of the Commitee, the specifications of the goods required by the Government were relaxed so as to enable more Indian cotton, particularly short-staple, to be used in the manufacture of such articles. The "Grow More Food" campaign on a country-wide basis was started, in which the cultivators were advised to grow more food-crops in the place of the short-staple cotton. The Government of Bombay stopped facilities for the movement of unwanted short-staple cotton to Bombay. The Broach, *Oomras* and the Bengals contracts were replaced by a new "Indian Cotton Contract" with fine *Jarilla* ¾-inch staple as the basis. All these effected in the reduction of the Indian short-staple cotton acreage by 43 per cent. Besides the above short-range or emergency plan, the Committee had a long-range policy as well. India at present consumes annually over six lakhs bales of foreign cotton, mostly of staple above one inch while the production in the country of similar cotton up to one-inch staple length amounts at present to 161,000 bales. The Report shows that the aim of the Committee has been one of financing schemes of research which would produce suitable long-staple varieties to meet the requirement of the Indian mill industry, the best customer of the Indian cotton. Further the Committee did not lose sight of the interest of the grower for it passed a resolution in its July 1943 meeting that the Government should fix equitable minimum prices for the different descriptions of cotton in consultation with the Committee and that the Government should be prepared to buy any cotton whenever offered to it at the minimum prices. Despite war conditions, with comparatively leaner funds, the activity of the Committee continued as of old and good progress was recorded in each branch. The area of improved cotton from 24 per cent. of the total cotton acreage in 1938-39 rose to 54 per cent. of the total in 1942-43. The improvement in the staple of the Indian crop has been noteworthy as the proportion of cotton of ⅞-inch staple and above to the total increased from 30 per cent. of 1922-27 to 38 per cent. in 1937-42, to 45 per cent. in 1941-42, and to 60 per cent. in 1942-43. The production of medium- and long-staple cotton in 1942-43 increased by 75 per cent. as compared with that of 1922-27. The Committee has been taking steps to increase the production of cotton of staple length over one inch of which over six lakhs bales are imported annually from abroad. The production of this class of cotton which was nil in 1922-27 amounted to 594,000 bales in 1942-43.

SCIENCE NOTES AND NEWS

Addressing the Institute of Engineers on 'Some scientific factors in post-war Industrial Development', Sir Shanti Swarup Bhatnagar said: "In advanced countries all scientific research is now generally administered by one Government Department. In this country, even so closely related subjects as Agricultural Research and Industrial Research are under separate departments. It is obvious that any large-scale programme of industrial developments should, at the same time, envisage a correspondingly large-scale agricultural development of the country. It is fortunate that on the question of India's agricultural development there is no difference of opinion amongst the politicians, the scientists and the industrialists of the country or those of Great Britain. It is only with respect to industrial development that there seems to be a difference of opinion to the extent and the development which should form our targets. Politics, not science, has been responsible for this lack of decision. The advantages which a co-operative programme of development presents have also been clouded by political considerations.

Sir Shanti Swarup gave a comprehensive survey of the scientific services that would be required, the work of Government Departments in publishing scientific material, of research associations, commodity laboratories

which had sprung up in Europe and America largely as a result of the industry agreeing to a levying of cess for research purposes, and patent laws. The speaker said that it was painful to notice that in spite of the training given in our universities and technical institutes there was a great paucity of suitable technical talent in this country. He thought there would be need of foreign talent and although national talent should be developed as soon as possible, in the initial stages we should have to import foreign experts for many industries.

It is understood that the Council of Scientific and Industrial Research has under consideration the question of building a Road Research Station and Laboratory.

A scheme costing about Rs. 4 lakhs for the reorganisation of pharmaceutical education in the Province, has it is learnt, been drawn up by the Sub-Committee appointed by the Post-War Reconstruction Committee of the Government of Bengal. The Committee consider that there should be at least two colleges of pharmacy in Bengal for higher training of pharmaceutical graduates, and several subsidiary centres in various Government and non-Government medical schools for the training of licentiates in pharmacy.

A comprehensive scheme for the improvement and development of tobacco in India has been sanctioned by the Governing Body of the Imperial Council of Agricultural Research at a cost of Rs. 16 lakhs. The direction of this work will be taken over by the Indian Central Tobacco Committee which is likely to be set up next winter. This Committee will be responsible for research, development and marketing of all kinds of tobacco grown in India and for its finances the Government is already allotting Rs. 10 lakhs annually from the Tobacco Excise Fund.

For the expansion of the Department of Chemical Technology, University of Bombay, Sir Vithal Chandavarkar, Chairman of the Mill-owners' Association, has donated a sum of Rs. 400,731. About a lakh and a half of the amount is to be utilised for the erection of a pilot plant laboratory for dyestuff technology; half a lakh is set apart for a laboratory for advanced research in textile chemistry and another half a lakh for special equipment in connection with studies on modern methods of finishing textiles. A lakh and a quarter will be reserved for the institution and maintenance of two research assistantships in textile chemistry.

The proposal made by the Syndicate of the Andhra University at its meeting held on 10th June 1944 to confer on His Excellency Captain the Honourable Sir Arthur Oswald James Hope, G.C.I.E., M.C., Governor of Madras and Chancellor of the University, the Honorary Degree of D.Litt., has been agreed to by His Excellency the Chancellor of the Andhra University. The Degree will be conferred at the next Convocation which will be held on Saturday, 18th November 1944.

On the recommendation of the Committee of Award supported by the Syndicate of the Andhra University, H. E. the Chancellor has been pleased to offer the Sir C. R. Reddi National Prize to Sir C. V. Raman, who has accepted it. Sir C. V. Raman will receive the Prize in person at the forthcoming Convocation of the Andhra University to be held on 18th November 1944.

Pursuit to a resolution passed at the recent meeting of the Central Committee of the All-India Manufacturers' Organisation, Bombay, advocating protective Government measures for essential industries particularly those started during war, the Working Committee invites interested industrialists to get immediately in touch with the Secretary at its address: Industrial Assurance Building, Opp. Churchgate Station, Bombay, to enable the Organisation to urge where necessary, the adoption by Government of one or more of the following among other safeguarding methods:—(*a*) Protective tariffs, (*b*) bounties and or subsidies, (*c*) guarantee of interest on invested capital, (*d*) facilities for importation of essential raw and semi-manufactured materials, (*e*) provision by means of priorities of suitable equipment and technical assistance.

It is hoped that the parties interested will assist the Organisation in its work by immediately forwarding complete statements including (1) the date of the establishment of the factory, (2) the amount of capital invested, (3) the output and the value of products, (4) the nature of the difficulties experienced in detail, (5) the nature of protection desired in detail.

The information supplied will be kept confidential.

Informations are particularly sought for among others the following types of industries:—(1) Industries started or developed with further capital investments at the instance of the Government, (2) industries which are in the nature of key or defence industries, (3) industries which can be developed into or as adjuncts of heavy industries, (4) industries in respect of which it is essential for the country to be independent of foreign supplies in times of war, (5) industries providing articles serving as ancillaries for other industries, (6) industries utilizing waste products of other industries, (7) industries catering to educational and cultural developments of the country, (8) industries manufacturing such consumers' goods as are required to raise or maintain at least the minimum standard of life of the people.

Prof. B. V. Bhide, one of the members of the Governing Body of The Indian Drugs Research Association, Poona, has sent us the following appeal:—

"Indian Drugs" is a very vast and an equally important field for research, both from the scientific and national points of view.

The research in the field of drugs necessitates an adequate knowledge of various physi-

cal and natural sciences, like chemistry, botany, pharmacology, medicine and others. With the advance of modern sciences and the analytical method of study, it is impossible for one individual to be a master of all and a team-work with proper co-ordination is extremely essential to make any real progress in the field. The realisation of these facts has already created many co-ordinated research organisations in other countries advanced in physical sciences, and the same is responsible to bring the Indian Drugs Research Association into existence.

We have fortunately been successful in enlisting an active support of various experts in their own fields and we have already secured the co-ordination of some of the existing laboratories, before reaching a stage when the Association can have its own equipment and staff. But even to utilise the existing institutions for this purpose, the cost of the new investigation work shall have to be incurred by the Association. The amount of the memberships and subscriptions can never cope with the cost of such a work. As such, we request the rich and interested to extend a financial support to the work of the Association. This is not a commercial body manufacturing any patent drugs. The aim of the body is purely scientific and pure work many a time leads to some applications in the immense spheres of industries, and we hope that the industrialist will realise the necessity to maintain such pure work out of their own profits.

The duty of the Association is to collect a new knowledge, which will be a property of our nation and humanity and we appeal to all individuals and institutions interested in the welfare of the nation to extend their help and co-operation for the advancement of knowledge which will be our real heritage to the posterity. You can help the Association—

(1) by enrolling yourself as a member, patron or a donor;
(2) by requesting your friends to enrol themselves in any of the suitable categories;
(3) by suggesting new lines of work in our field;
(4) by communicating the results of your own work and observations to the Association; and
(5) by rendering any other kind of help which will benefit the Association in furtherance of its aims and objects.

All communications and enquiries may be addressed to Dr. G. S. Pendse, Hon. General Secretary, The I.D.R.A., 631|27, Sadashiv Peth, Poona 2.

Watumull Foundation is offering (1) a travelling Fellowship for one year, and (2) ten scholarships to Indian men and women to carry on higher studies and research in American universities and institutions for advanced agricultural and technical education for two years. The travelling Fellow must be (*a*) a Professor in an Indian University or College; or (*b*) a recognised scientist with the highest type of professional attainments. He must indicate in his application the nature of the research work, investigation or special study he desires to pursue during the stay in the United States. The applicant finally selected will receive a stipend covering travelling expenses to the United States and return to India, plus an allowance of approximately Rs. 825 a month during the year. The ten scholars selected must have graduated First or Second Class M.A. or M.Sc., from an Indian University with research experience, or be graduate medical students with a M.B. degree from an Indian university with research experience; or be graduate engineers with a B.E. or B.Sc. degree in engineering; or graduates of agricultural colleges. Further particulars may be had from The United States Office of War Information, Dept. W., 293, Hornby Road, Bombay.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory during the month of August 1944, there were seven of slight intensity. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin (I.S.T.)	Epicentral distance from Bombay	Co-ordinates of epicentre	Depth of focus
		H. M.	(Miles)		(Miles)
3	Slight	05 25	1470		
7	Slight	09 56	10150		
8	Slight	15 03	4770		
14	Slight	20 52	3190		
15	Slight	18 18	4510		
18	Slight	17 04	3900		80
31	Slight	07 04	1510		

MAGNETIC NOTES

Magnetic conditions during August 1944 were more disturbed than in the previous month. There were 19 *quiet* days, 11 days of *slight* disturbance and 1 day of *moderate* disturbance, as against 5 quiet days, 20 days of slight disturbance and 6 days of moderate disturbance during the same month last year.

The quietest day during the month was the 20th and the day of the largest disturbance the 18th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days	
	Slight	Moderate
4–7, 9, 11–17, 19–22, 25, 26, 27	1–3, 8, 10, 23, 24, 27–29, 31	18

A disturbance of moderate intensity occurred during the month of August 1944 while one of moderate intensity occurred during August 1943.

The mean character figure for the month of August 1944 was 0·42 as against 1·03 for August 1943. M. PANDURANGA RAO.

1092-44 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

CURRENT SCIENCE

Vol. XIII] OCTOBER 1944 [No. 10

COCONUT SHELLS AS AN INDUSTRIAL RAW MATERIAL

IV. COCONUT SHELL CHARCOAL: (A) COMMERCIAL

THE second article of this series[31] dealt with miscellaneous uses of coconut shells as such and with their value as fuel. The uses there considered were only of local importance. The present article is concerned with a commodity—Coconut Shell Charcoal—which, during the War of 1914-18, and again in the years immediately preceding the present war, acquired general commercial importance.

Charcoal is essentially a more or less impure form of carbon obtained from various animal or vegetable matter by ignition out of contact with air. Charcoal burning is a very ancient art; and the use of wood charcoal for smelting must date back to the earliest use of metals, which has been put back as far as 4000 B.C. The description of charcoal burning in Theophrastus' (370-285 B.C.) *Enquiry into Plants*[42] is supplemented by practical information which sometimes has a curiously modern ring: "Different kinds of charcoal are used for different purposes—thus in iron mines they use that which is made of sweet chestnut when the iron has already been smelted, and in silver mines they use charcoal of pine-wood—Smiths require charcoal of fir rather than oak; it is indeed not so strong, but it blows up better into a flame, as it is less apt to smoulder." "Worst of the woods mentioned is oak, since it contains most mineral matter."

Charcoal prepared from coconut shells does not appear to have come early into use in coconut-growing countries. Thus, although Robert Knox in the seventeenth century describes iron smelting as for long practised in Ceylon, he makes no specific mention of coconut shell charcoal. It appears likely moreover that wood charcoal rather than shell charcoal entered into the manufacture of gunpowder, described in 1818[43] as "of very ancient practice in the country" (Ceylon); the latter is indeed not very suitable for the purpose.

Bennett (1843)[19] and later authors (*e.g.*, Seeman, 1856),[44] mention the conversion of coconut shells into "lampblack, and charcoal; which latter, when pulverized, forms an excellent dentifrice". Lampblack, so referred to, is probably a preparation made by condensing the soot from burning shell, though Grisard and Vanden-Berghe (1889)[21] seem to suggest the use of ground shell charcoal in paints, and as late as 1919 a writer in the *Mysore Engineers' Association Bulletin*[45] used the charcoal from dry distillation of shells with linseed oil as a blackboard paint and said that the finely powdered "shell-coke" (as he called it) "may probably prove to be a good substitute for lampblack". What is nowadays described as lampblack is essentially the soot from an unobstructed hydrocarbon flame and has properties which could hardly be reproduced by powdered charcoal.

Regnaud (1856),[22] who evidently wrote more at first-hand than most of the nineteenth century authors quoted, notes the use of shell charcoal in the Maldives and elsewhere in metal working: "La coque du coco ... Transformée en charbon, elle devient précieuse pour le travail des forges, et ne le cède en rien a la houille entre les mains des Maldiviens et des habitants des ilots de la mer de l'Inde, qui sont sous la dépendance de Maurice." A cor-

respondent of the *Madras Mail* in 1886[46] stated that "charcoal of the coconut shell is specially used by native goldsmiths in melting gold and silver". In Ceylon, shell charcoal is still considerably used for such small-scale metal work, including precious metals and brass.

The desiccated coconut and machine-made coir industries developed in Ceylon from the end of last century; in mills devoted to these manufactures the large accumulations of shells were and are used as fuel (*cf.* ref. 47) and frequently converted into charcoal used for producer gas engines. There are also references to the use of shell charcoal in copra drying, and the manufacturers of the "Chula" copra drier were stated in 1914[48] to recommend this fuel; such use has not, within the writer's knowledge, ever been general.

The War of 1914-18 brought into use the product known as "activated carbon" as a means of defence against poisonous gases in warfare. Coconut (and other nut) shells give products particularly active for this purpose, and were developed considerably in the U.S.A. Brown and Merrill (1919)[49] state: "In 1918 the United States military authorities had an extensive organization for securing large quantities of this charcoal in the Philippines." Much of the work on research and manufacture at that time was secret and precise statistics of production do not seem to be available.

From 1933 fairly extensive exports of coconut shell charcoal were made from Ceylon; Tabel I shows the quantities exported in the years 1933-41 inclusive.

TABLE I

Exports of Coconut Shell Charcoal from Ceylon

Year	Amount tons	Value Rs.	Value per ton Rs.
1933	2,019	90,541	44·85
1934	6,234	350,096	56·30
1935	7,667	365,668	47·68
1936	6,751	377,137	55·86
1937	13,455	977,708	72·66
1938	10,997	823,781	74·91
1939	18,568	1,361 880	73·35
1940	14,967	758,739	50·69
1941	1,697	68,807	40·55

Table II shows the distribution of the Ceylon exports from 1936-39 inclusive.

TABLE II

Distribution of Coconut Shell Charcoal Exports from Ceylon (in Tons)

	1936	1937	1938	1939	Total 1936–39
U.K. ..	3,223	7,448	4,077	4 085	18.833
France ..	3,353	5,603	6,570	14,272	29,798
Holland	175	100	100	200	575
Italy ..	..	300	.	..	300
Roumania	..	..	250	..	250
Others ..	..	4	..	11	15
	6,751	13,455	10,997	18,568	49,771

In the same period there were some sporadic shipments from the Philippines, where, however, there were no official trade figures prior to 1939. In 1936-37 there seem to have been shipments of at least 1,000 tons to Italy and Germany and for the first six months of 1939 the Bureau of Customs issued the following figures.[50]

TABLE III

Exports of Coconut Shell Charcoal from the Philippines

(First 6 months, 1939)

	Tons	Value (Pesos)
Great Britain	139	10,242
France	225	5,827
Japan	15	194
	379	16,263

There was little development in Malaya, shipments being only recorded of 80 tons exported in 1940;[51] and whilst there was some apprehension in Ceylon of competition from the Netherlands East Indies in 1938, output from this source was apparently not large. Only comparatively small quantities were supplied from there to Japan, Germany, Denmark and France.[52]

In South India, shell charcoal has been made for service purposes, but particulars have not been released.

All of these exports were of crude charcoal; there has been so far no development of the manufacture of "activated carbon" in coconut-producing countries, although one large shipping firm in Ceylon installed plant for granulating crude charcoal, which in granular form (ready for processing) was supplied for French requirements up to 1939. The possibility of the local manufacture of active carbon has been considered in the Philippines, in India and in Ceylon, and reference will be made in the next article of this series to the preliminary investigations carried out in these countries.

PREPARATION OF SHELL CHARCOAL

Shell charcoal is usually burned in pits, which may be anything from a simple hole in the ground to large brick-lined pits with steel lids. Accounts of the procedure adopted in Ceylon are given by Cooke (1932)[53] and by Child (1940).[54] Similar accounts have been published in attempts to encourage production in other countries; these include, for Malaya, an article by Cooke (1935),[55] and for Fiji, a note by Jack (1940).[56] In New Guinea, Hutchinson has described a method of burning shells in 40-gallon oil drums (1941).[57]

Up to the present patent steel and brickwork kilns such as the Hornsby Patent seem nowhere to have come into use. In the writer's opinion, a portable type of kiln such as has been used in England during the War (1944)[58] would be very suitable for a raw material like coconut shells, production of which is scattered.

The production of retort charcoal by carbonization with recovery of by-products is now

carried out in the Ceylon Government Acetic Acid Factory. Further reference will be made to this in a later article on Distillation of Shells.

It may be remarked here that shell charcoal burning in pits is not a pleasant occupation either for those who conduct it or for dwellers in the neighbourhood. The smoke is peculiarly acrid and deleterious to metal work and fabrics. Charcoal burning has, in fact, been held by a Ceylon court to be a "nuisance" trade.

Yield of Charcoal

The yield of charcoal from pit burning of shells averages between 29 and 30 per cent. by weight of the original shells, when the operations are efficiently conducted on clean dry shells. Adopting a figure of 29 per cent. Table II (*b*) of Article III of this series[41] can be extended to show the relation between out-turn of copra per 1,000 nuts, and the number of shells required to make a ton of charcoal. A usual working average is that 20,000 whole dry shells go to a ton of charcoal (this corresponds to 4,400 nuts per long ton of copra).

It may thus be estimated that in Ceylon in 1939, some 360 million whole shells (= about 60,000 tons) were converted to charcoal or about one-fifth of the Island's total production (*cf.* above Table I and also Table I of Article III, ref. 41, p. 150). Charcoal production could not have expanded much beyond the 1939 output, since some 60 per cent. of the shells produced annually are used for copra drying. Nevertheless, the Ceylon authorities were subjected to ill-informed criticism early in 1940 for failing to secure a possible contract for a further 2,000 tons a month.[59]

Quality of Pit Charcoal: Importers' Specifications

Good quality coconut shell charcoal should be uniformly black in colour and free from carbonised fibre (from adhering husk on the original shell). Broken edges should show a shining black surface and the characteristic sharp conchoidal* fracture. Dropped on a stone floor well-burned pieces give a clear ring; under-burned pieces a dull sound. Over-burned pieces are very thin and brittle, and are not favoured for inclusion in samples for export as they easily go to dust.

Besides over- or under-burning, common faults of pit charcoal are (*a*) excessive moisture, due to too much water being used to damp down when opening the pit, (*b*) high salt content, due to brackish water being used to damp down, (*c*) contamination with sand or earth. Importers' specifications aim at limiting these faults.

Such specifications nearly always impose limits for moisture, ash and volatile matter, and some include limits for chlorides, water-soluble matter and alkalinity. They usually also have limits for sizes of pieces as determined by screening through sieves of various mesh. Table IV gives a summary of importers' specifications.

* *i.e*, "a fracture presenting smooth shell-like convexities and concavities" (*Oxford English Dictionary*).

Methods of Examination

(*a*) Sampling in the case of bulk products such as minerals, coal, soil, copra and charcoal, presents considerable difficulties. Analytical determinations on charcoal are performed on powdered quantities of a few grams and it is apparent that great care must be exercised in order that such small samples shall be truly representative of the original bulk.

In drawing from bulk the primary sample to be sent for examination, it is necessary to open and sample more bags than is usually recognized. A useful rule, which has been found adequate for copra[61] and for feeding stuffs,[62] is to take a number of bags equal to the square-root of the total number. In the case of charcoal, this number of bags should be opened and turned out, each lot mixed up, and three pounds drawn from each lot. The quantities so drawn are bulked.

Further sampling by the analyst is (according to Specification E) done as follows. The sample received is reduced to 5 lbs. by direct quartering; this amount is broken through quarter-inch mesh and again sampled by quartering down to 1 lb. This is broken through an eight-mesh sieve and quartered down to 100 gms. From this final sample is drawn 30 gms. which is finely ground through a sixty-mesh, and used for determination of moisture, ash and volatile matter.

(*b*) *Moisture.*—According to Specification E, 20 gms. powdered charcoal (sixty-mesh) are dried at 110° C. for two hours, cooled in a desiccator and weighed. D uses 1 gm. powdered charcoal and dries at 120° C.

(*c*) *Ash.*—According to E, 2 gms. of the dry charcoal from the moisture determination are ashed in a muffle furnace; being first burned off at a low temperature and finally at 950° C. for 1½ hours. In the writer's experience (see below) it has been found preferable to determine the sulphated ash, since it is somewhat difficult to get consistent results by the above method owing to the volatility of potassium salts in the ash.

(*d*) *Volatile Matter.*—The "volatile matter" is an arbitrary comparative figure depending on the method of determination adopted.

E proceeds as follows: Into a weighed porcelain crucible (without lid) of diameter 1¼", 1 gm. powdered charcoal from the moisture test is weighed. The crucible is placed in a Davies Crucible Furnace, and heated by means of a Téclu burner at 950° C. for exactly 7 minutes; cooled in a desiccator and re-weighed.

According to Specification B: volatile matter is determined by heating over a Bunsen burner in a closed platinum crucible for 10 minutes.

The French Specification D heats the charcoal in a closed crucible contained in a larger crucible packed with dry charcoal so that the smaller crucible does not come into contact with the flame (1 hour at 700-800° C.).

The writer was not able to obtain very concordant results by the last method. The first method was preferred and gave results satisfactory for comparative purposes.

(*e*) *Water-Soluble Matter.*—For this and the following two determinations, Specification E

TABLE IV
Specifications for Commercial Shell Charcoal

	A	B	C	D	E
	London firm (Cooke, 1935, Ref. 55)	London firm 1936[60]	Manchester firm 1936[60]	French firm 1936[60]	Manchester firm 1937[60]
Moisture. Not more than ..	10%	5%	10%	5–6%	10%
Ash. Not more than	..	3–4%	..	1–2%	2%
Volatile matter. Not more than	15%	15%	15%	12–16% (sample rejected if over 20%)	30%
Chlorides. Not more than ..	..	.	(see below)	.	1·0 mg./gm. (but should be below 0·5 mg./gm.)
Water-soluble matter. Not more than	..	..	..	..	0·5% (but should be below 0·25%)
Alkalinity. Not more than ..	..	..	..	..	0·5% (but should be below 0·2%)
Size	Not < 10% on 1" mesh Not > 5% passing ¼"	..	Not < 10% on 1" mesh Not > 10% passing ¼"	..	On 1" not < 10% Thro' 1" on ¾" 10–20% ,, ¾" on ½" 30–40% ,, ½" on ⅜" 15–25% ,, ⅜" on ¼" 10–20% ,, ¼" not > 5%
Other remarks	..	..	Free from contamination with salt water. Free from foreign matter. Shells to be of good thick quality.	..	..

uses the remainder of the coarse (eight-mesh) 100 gm. sample. Ten grams are added to 100 c.c. of boiling distilled water, boiled for 10 minutes, filtered and washed with 50 c.c. of cold distilled water. The filtrate is evaporated and the residue dried at 110° C. and weighed.

(*f*) *Alkalinity* (*or Acidity*) *and Chlorides.*—Ten grams coarse sample are treated as in (*e*) and the filtrate titrated to methyl orange with N/10 sulphuric acid (or caustic soda if filtrate is acid). Results are expressed as c.c. N/10 acid (or alkali) per gm. of dry charcoal.

Chlorides are determined on the so neutralised filtrate by titration with standard silver nitrate solution, using chromate indicator; expressed as mg. Cl' per gm. of dry charcoal. The writer has determined chlorides (see below) on the soluble ash. The results are reasonably concordant with those obtained by the foregoing method.

All determinations except (b) are expressed as per cent. of *dry* charcoal.

(*g*) *Screen Test.*—Specification E recommends that at least a 1 kilo. sample should be used. The writer prefers a larger sample if available. Each screen is well tapped until no more sample passes through.

RESULTS OF EXAMINATION OF COMMERCIAL SAMPLES

Thirteen samples locally produced* have been examined by the writer.

(*a*) *Moisture.*—Only five samples had moisture per cent. below 5; all but one, however, were below 7 per cent. and that was 8·1 per cent., the mean being 5·5 per cent. A specification limit of 5·0 per cent. seems rather stringent and 7·5 per cent. is suggested.

(*b*) *Ash.*—The range of figures for ash on eleven samples was 0·8 to 2·2 per cent., only one however being over 1·6 per cent., with a mean of 1·3 per cent. Sulphated ashes (13 samples), ranged from 1·2 to 3·2 per cent., only two samples (2·1 and 3·2 per cent.) being over 1·9 per cent.; mean 1·7 per cent. A specification limit of 2·0 per cent. seems quite satisfactory. The two samples which failed to pass this specification were known on other grounds to be bad. That high ash figures indicate contamination with sand or soil is shown by the results of ash determinations on material which passes a quarter-inch or sixth-inch mesh:—

SAMPLE I

Passing ¼" mesh	2·6% (Specification limit 5·0%)
Ash on material remaining on ¼" ..	1·50%
Ash on material passing ¼"	16·2%
Ash on sample as received	1·92%

SAMPLE II

Passing ⅙"	5·4%
Ash on material remaining on ⅙" ..	1·1%
Ash on material passing ⅙"	11·2%
Ash on sample as received	1·64%

* i.e., in Ceylon.

It may be observed that an average ash content of 1·7 per cent. of the charcoal corresponds to 0·58 per cent. ash on the original shells, which is in accordance with the figures of Phillips and Goss (1940),[4] Georgi (1941)[5] and the writer (1938)[2] quoted in the first article of this series (1943, p. 292).[17]

(c) *Chlorides.*—Twelve samples examined by the writer averaged 0·41 mg. Cl′/gm. dry charcoal. Four samples exceeded 0·5 mg. Cl′/gm., three of these only slightly; the other sample (1·34 gr. Cl′/gm.) was one of those referred to above as known to be unsatisfactory. Specification E is thus a reasonable one.

A figure of 0·41 mg. Cl′/gr. dry charcoal corresponds to ·014 per cent. Cl′ on the original shells or 2·1 per cent. Cl′ on the ash (*cf.* ref. 17).

(d) *Volatile Matter.*—Using the French method the writer obtained high and variable results and the first method was preferred. Of twelve samples, six gave figures below 15 per cent., three between 15 and 20 per cent., two slightly over 20 per cent. (21·2 and 21·9) and one 29·5 per cent. The last sample was obviously under-burned; omitting this, the average was 16·0 per cent. A limit of 15 per cent. is perhaps a little stringent; 30 per cent. is unnecessarily tolerant.

(e) *Screen Test.*—Importers do not insist on accurate compliance with such a detailed specification as E, but expect other limits of not less than 10 per cent. to remain on a one-inch mesh, and not more than 5 per cent. to pass a quarter-inch to be observed. There is some breaking up in transport, but less than might be expected.

Other Properties of Commercial Coconut Shell Charcoal

Elementary analyses for carbon, hydrogen and oxygen do not appear to have been recorded for coconut shell charcoal. What is referred to as "Fixed Carbon" is the figure obtained by deducting the sum of percentages of moisture, ash and volatiles from 100. Thus a sample of shell charcoal from Ceylon examined by the Imperial Institute in 1916[63] was reported as moisture 4·7, volatile (at low red heat) 18·2, Ash 1·0, fixed carbon 76·1. Total 100·0 per cent.

Calorific Value

The same sample was reported as having a calorific value of 7,529 cals. per gm. Cooke (1935)[53] found a gross calorific value of 7,640 cals. per gm. dry weight. Expressed in B. Th. U. per lb., the calorific value of coconut shell charcoal should not be less than 13,000.

Sulphur

The Imperial Institute (*loc. cit.*) found 0·05 per cent. sulphur in the sample examined by them. This was probably present in the form of potassium sulphate and is in any case negligible.

Cost of Making Pit Charcoal

It is perhaps not very useful at the present time to discuss the cost of producing pit charcoal from coconut shells since what details are available relate to pre-1940 conditions. The figures given for Malaya by Cooke[53] and for Ceylon by Child[40] may, however, have some comparative value.

According to Cooke, in Malaya in 1935, charcoal was being manufactured and bagged on contract at 28 Straits cents per picul. Cost of bags, handling and road transport brought the total to about 60 cents per picul f.o.b. Singapore (or about Rs. 16 per ton).

Child, writing in early 1940, stated that in Ceylon a usual contract charge for burning shells, sorting and bagging was Rs. 4·00 a ton. Bags cost Rs. 3·00 and transport about 20 cents per ton mile. The cost f.o.b. Colombo was, therefore, from localities about 30 miles from Colombo about Rs. 13·00 per ton plus value of shells. Taking the latter at Rs. 1·50 per 1,000, this gives a cost at Colombo of Rs. 43·00 per ton, assuming 20,000 shells to a ton of charcoal. In practice, the cost of shells became in Ceylon dependent on the demand and price paid for charcoal (see Article II, ref. 31, p. 5). The industry did not develop in Malaya despite its lower costs, presumably because of the longer distance and higher freight to Europe.

Packing, Storage and Shipment

Since accidents have occurred both by sea and land through cargoes or stocks of charcoal becoming re-ignited (spontaneous combustion is doubtful), it is made a condition of shipment that charcoal shall be spread out and freely exposed to the air for at least fourteen days before packing. It is usually packed in strong gunny bags (coir bags have been used) containing 90 to 130 lbs. (generally 1 cwt.). Twelve 1 cwt. bags go to the shipping ton (50 cubic feet).

The shipment of granulated charcoal already referred to had distinct advantages on account of more economical stowage, besides the preference of buyers for charcoal in a partially prepared state for activation.[64]

Long storage (for over six months) is found to result in deterioration of the bags by chemical action, and bulk storage is preferable when immediate shipment is not possible. Obviously such storage must be in dry godowns. Bulk storage and consequent rehandling has the disadvantage of breakage leading to an increase of smalls and dust; rescreening may become necessary.

Uses of Coconut Shell Charcoal

Shell charcoal was developed from a minor local product used as fuel and in gas producers to a general commercial product owing to its value as a raw material for the production of Active Carbon. This forms the subject of the second section of this article.

Before concluding this section, however, brief reference must be made to the possibilities of coconut shell charcoal as a fuel for gas producers for motor vehicles.

Gas Producers for Motor Vehicles

It is not necessary here to discuss at any length the general subject of gas producers for motor vehicles, especially as a detailed review has recently been published by the Imperial Forestry Bureau (1942).[65] Reference may also be made to a leaflet of the Forest Research Institute, Dehra Dun (1942),[66] on

the subject of the quality of charcoal required for producer gas plants.

Little study seems to have been devoted to the possible use of coconut shell charcoal for this purpose. The writer made certain enquiries in Ceylon and S. India in 1942-43 from users of automobile gas producers, some of whom stated that commercial shell charcoal tried by them contained too high a percentage of tar products with the result that the gas filters became clogged very quickly and tar fouling of the pistons and valves occurred. The distillative products of shells differ somewhat from those of wood (see Article V of this series) and it is possible that their more phenolic nature tending to resinous tar formation may be a drawback to the use of shell charcoal in this field. On the other hand, it is possible that a higher grade of retort charcoal would be suitable and it certainly seems desirable that further investigations should be carried out. The utilization of shell charcoal in this way would be of economic interest to coconut-growing countries. The writer would be glad to hear of any information obtained from trials on this subject carried out by investigators in India.

REGINALD CHILD.

Previous articles in this series have been.—17. Child, R., "Coconut Shells as an Industrial Raw Material. I. Composition of Shells". *Current Science*, 1943, **12**, 292–94. (See this article for references 1-16.) 31. —, II. "Miscellaneous Uses: Fuel", *Ibid.*, 1944, **13**, 4–6, (for references 17-30.) 41. —, III. "Estimated World Production", *Ibid.*, 1944, **13**, 150–52 (for references 31–40.)

42. Theophrastus, "Enquiry into Plants", V, ix, 1–4. A. Hort's Translation, Loeb Classical Library, 1916, **1**, 467–71. 43. de Silva, C. R., "Ceylon under the British Occupation, 1795–1833", Colombo, 1941, **1**, 178. 44. Seemann, B., "Popular History of the Palms", London, 1856, p. 167. 45 "Coconut Gas and Coke", *vide Mysore Economic Journal*, **5**, No. 9, reprinted in *Tropical Agriculturist* (*Ceylon*), 1920, **54**, 58-60. 46. See *Tropical Agriculturist* (*Ceylon*), 1886, **6**, 272. 47. *cf.* "L'Utilisation des coques de noix de coco", *Bull. Econ. de L'Indochine*, 1909, **12**, 388-9. 48. Hamel Smith, H., and Pape, F. A. G., "Coconuts: The Consols of the East", London, 1914 (2nd edition), p. 405 49 Brown, W. H., and Merrill, E. D., "Philippine Palms and Palm Products", *Bulletin No. 18*, *Bureau of Forestry*, Manila, 1919, p. 64. 50. "Coconut Shell: Present and Potential Uses in Production of Carbon in the Philippine Islands", *Foodstuffs Round the World*, 15th December 1939, **3**, No. 50 (U. S. Dept. of Commerce, Washington, D.C.). 51. Grist, D. H., "Malayan Agricultural Statistics, 1940", *Department of Agriculture, Straits Settlements and Federated Malay States, Bulletin* (*Economic Series*). *No. 12*, Kuala Lumpur, 1941, p. 80. 52. *Ceylon Daily News*, 29th January 1938. 53. Cooke, F. C., "Investigations on Coconuts and Coconut Products", *Bull. No. 8* (*General Series*), *Dept. of Agric., S.S. & F.M.S.*, 1932, pp. 47–48. 54. Child, R., see reference 40 and also *Tropical Agriculturist* (*Ceylon*), 1940, **95**, 99–104. 55. Cooke, F. C., "Charcoal Manufacture from Coconut Shells", *Malayan Agric. J.*, 1935, **23**, 172–4. 56. Jack, H. W., "A Note on Charcoal Making", *Fiji Agric. J.*, 1940, **11**, 105. 57. Hutchinson, R. C., "Preparation of Coconut Charcoal", *New Guinea Agric. Gaz.*, 1941, **7**, 204–5. 58. "New Methods in Charcoal Burning", *Sport and Country* (*London*), 1944, **177**, 146–7 (March 3, 1944). 59. Child, R., "Coconut Shells", *Young Ceylon* (Colombo), 1940 (July–August Number), pp. 34–35. A popular article reviewing briefly and in non-technical language the chemistry, actual and potential uses of coconut shells. 60. Except for A, the specifications quoted were kindly obtained for the writer by the Imperial Institute, London. 61. Scott, I. L., "Trials of Certain Methods of Sampling Copra", *Year-Book of the Department of Agriculture, Gold Coast*, 1928, paper 25, p. 190. 62. Munch, J. C., and Bidwell, J. L., "What constitutes an adequate Sample?" *J. Assoc. Off Agric. Chem.*, 1928, **11**, 220–22. (See also Vallery, *Ann. Falsif. et Fraudes*, 1925, **18**, 597–605, and Mika, J., *Z. Anal. Chem.*, 1928, **73**, 257–64 for discussion of the theory of sampling.) 63. "The Distillation of Wood and other Vegetable Products", *Bull. Imp. Inst.*, 1916, **14**, 566–77. 64 See *Year-Book of the Planters' Association of Ceylon for 1940* (Ceylon Association in London Section, pp. 22–23), Colombo, 1941. 65. Kissin, I., "Gas Producers for Motor Vehicles and their Operation with Forest Fuels", *Imperial Forestry Bureau Technical Communication No. 1*, 1942, p. 37 (Oxford, England). 66. "Some Factors Affecting the Quality of Charcoal for Producer Gas Plants", *Indian Forest Leaflet No. 18* (*Chemistry*), Forest Research Institute, Dehra Dun, U.P., 1942, pp. ii + 6.

JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

It is a matter of great satisfaction that during the short span of two years and a half, the *Journal* has established itself not only as the official organ of the Council of Scientific and Industrial Research but also as the *Journal* to whom the world will look to as the medium reflecting the progress of industrial research in this country. The *Journal*, published as a quarterly at its inception, has now been made into a monthly to meet the growing demand for the prompt publication of the results of industrial research pursued in the various laboratories. Further, the Journal has been largely responsible for establishing the long-felt *liaison* between the industrialists and the scientific workers.

The get-up and format of the *Journal* have been greatly improved and considering the difficult times during which this journalistic enterprise has been launched, the *Journal* has to its credit a record of substantial progress. The Editorial Board and the distinguished Editor deserve to be heartily congratulated.

AN ELECTROLYTE-FREE MEDIUM FOR UNSTRIATED MUSCLE

By INDERJIT SINGH, F.A.Sc.
(*Department of Physiology, Medical College, Hyderabad, Sind*)

It is generally believed that muscle becomes inexcitable in the absence of sodium chloride, and that calcium is necessary for the contraction of plain muscle. It was found, however, that *Mytilus* muscle could contract, if deprived of calcium for an hour, and subsequently treated with sodium citrate (Singh, 1937) and frog muscle in the complete absence of sodium chloride and calcium (Singh and Mrs. Singh, 1943).

It has been further found that frog stomach is able to contract and respond normally to stimuli in the absence of all electrolytes (8 experiments) and guinea-pig uterus feebly (2 experiments), if the osmotic pressure is reduced by 50 per cent. by immersing in a half-tonic solution of sucrose (B.D.H., A.R.), the osmotic pressure of which corresponding to about 0·3 per cent. sodium chloride or 0·11 M sucrose. Glucose is not so good as sucrose in this respect.

The frog muscle was immersed in the sucrose solution, which was renewed every 15-30 minutes. At first the excitability is depressed the spontaneous contractions, having ceased, the muscle passing into a tonic contraction, but after an hour or more it begins to recover. The spontaneous contractions may be twice as big as in the saline solution. The muscle responds to alternating current, the isometric contraction being 30-70 per cent. of that in saline solution, and to direct current, the isotonic contraction being just as big as in saline soluion. Unfortunately, owing to the war situation, acetylcholine was not available. Adrenaline produces inhibition as in the normal medium.

After recovery the muscle responds for about 2-3 hours after which the excitability diminishes. After about 4 hours the response to electric current is abolished, though the spontaneous contractions persist for about 6 hours. It then passes into contracture.

The frog stomach muscle is a thin flat muscle, about one mm. in thickness, so that diffusion must be rapid; this does not apply to the guinea-pig uterus. The medium was free of electrolytes, though there are bound to be traces of ions diffusing out of the muscle. The conductivity of the solution was low as measured previously. How is it then stimulated electrically? If traces of ions conducted the current the strength of the current should fall below the threshold value, which for plain muscle is high. The muscle is then either hypersensitive to electric current, or is stimulated by the electric field, the muscle, solution and the electrodes forming a condenser. As there are hardly any ions outside, excitation is undoubtedly caused by mobilisation of ions inside the muscle fibres; so also the spontaneous contractions, as mentioned previously (Singh, 1939). In such excitation, therefore, the question of increase in permeability to permit ions to enter from the exterior does not arise. It has been found that during stimulation of muscle, there is no increase in permeability (Fenn, Noonan and Huage, 1941).

It is probable, that to produce their effect, the ions enter or get fixed to the muscle membrane, and when the muscle is deprived of electrolytes, these ions are only slowly liberated, thus preserving the properties of the membrane.

When the muscle is actively contracting, restoration of the normal osmotic pressure of the saline (the osmotic pressure may be increased above normal), causes a tonic contraction and depression of excitability. The reduction of the osmotic pressure of the solution will cause a dilution of the ions within the muscle fibres, so that it is clear that tonic contraction and depression of excitability is due to the action of ions inside the muscle fibres.

The muscle membrane is thus excited, if excess of ions, say potassium, is applied to its outer or inner surface. This will have a bearing on the mode of action of nerves. These may end outside the fibres or inside. If acetylcholine is liberated outside, then atropine would antagonise it. If, however, acetylcholine is liberated inside the cells, then atropine would not antagonise it, if the cells are not permeable to it. Dale has advanced such an explanation for the inability of atropine to antagonise certain cholinergic nerves; it is presumed that atropine is unable to reach the seat of action.

Diminution of potassium in the saline in certain instances, would cause a depression of excitability, by increasing the depressent action of ions inside the fibres; excess of potassium outside would directly cause a depression of excitability, so that an optimum concentration of potassium would be necessary. In familiar periodic paralysis, the reduction of the serum potassium (Aitken, Allott, Castleden and Walker, 1937), would cause a similar depression of excitability.

Excess of potassium outside the muscle fibres produce a tonic contraction and depression of excitability, which is antagonised by increase in osmotic pressure of the saline (Singh, 1939), by increasing the concentration of ions in the muscle fibres. The action of ions outside the muscle fibres is thus antagonised by those within and *vice versa*. A difference in concentration of ions on two sides of the muscle membrane thus causes a contraction, and depression of excitability. This may be related to potential difference on two sides, which is affected by changes in osmotic pressure (Cowan, 1934).

The action of ions on two sides of the membrane is thus antagonistic. Excitatory state on one side of the muscle membrane would be antagonistic to that on the opposite side, but

would be synergistic to an inhibitory state. Excitation may thus be caused by the following possible methods: (1) Increase of external excitatory state (*e.e.s.*). (2) Increase of internal excitatory state (*i.e.s.*) (3) External excitation by increase of internal inhibitory state (*i.i.s.*). (4) Internal excitation by increase of *e.i.s.* (5) External excitation by diminution of *e.i.s.* (6) Internal excitation by diminution of *i.i.s.* (7) External excitation by dimunition of *i.e.s.* (8) Internal excitation by diminution of *e.e.s.*

Of these eight conditions, the first has been experimentally produced by addition of excess of ions, such as potassium to the outside of the muscle, the second by increase of osmotic pressure (Singh, 1942), the third probably by adaptation to alternating current (Singh, 1944), the fourth by addition of ammonium outside and simultaneous increase of osmotic pressure of the saline (Singh, 1939; 1944), the fifth by removal of calcium (Sing, 1938), the sixth has not been produced, the seventh by decrease of osmotic pressure of the saline, the eighth by immersion in sucrose solution. Experiments thus fit into the theory.

Inhibition would be produced by opposite methods respectively: (1) Decrease of *e.e.s.*, such as by partial removal of sodium chloride from the guinea-pig uterus. (2) Decrease of *i.e.s.*, by the hypotonic sucrose solution. (5) External inhibition by increase of *e.i.s.*, by calcium in *Mytilus* muscle. (6) Internal inhibition by increase of *i.i.s.*, by adaptation to altĕrnating current. The rest have not been obtained experimentally.

Adaptation would be due to leakage of ions or to the production of a like state on the opposite side of the membrane. An excitatory substance on diffusion to the opposite side will become inhibitory and *vice versa*. This is in agreement with views of Wright (1942), who finds that anticholinesterases act as depressants outside the nerve-cells, but as convulsants inside.

Tone and slow relaxation appears to be caused by ions within the muscle fibres as well. How small concentrations of drugs act, it is not clear as yet.

1. Aitken, Allot, Castleden and Walker, *Clin. Sci.*, 1937, 3. 2. Cowan, S. L., *Proc. R. Soc.* B, 1934, **115**, **216**. 3 Fenn, W. O., Noonan, T. R., and Haege, L., *Amer. J. Physiol.*, 1941, **35**, 149. 4. Singh, I., and Mrs. Singh, I, *Proc. Ind. Acad. Sci.*, 1943, **18**, 58. 5. —, *J. Physol.*, 1936, **89**, 10; 1938, **91**, 398; 1939, **96**, 367; *Ind. Journ. Med. Res.*, 1942, **36**, 29; *Proc. Ind. Acad. Sci.*, 1944, **19**, 91.

THE DEPARTMENT OF INDIAN POSTS AND TELEGRAPHS

AN official publication describes the story of communications as set against a background of vast distances, varying climatic and geographical features, of hundreds of languages and dialects, of illiterate persons who have incomplete addresses written out for them, of 400 million people, more than 85 per cent. of whom live in 700,000 villages, of how one-fifth of the human race spread over an area as large as Europe, excluding Russia, keep in touch with one another. It is learnt that though the generation associating its mails with runners has long passed, runners and boats still convey mails over 84,000 miles out of a total of 157,000 miles. The Department disposes of 1,475,000,000 unregistered articles in a year and the number of complaints received is said to be 1 for every 100,000 articles. This would lead one to believe that the people are averse to complain and that the machinery for receiving and accounting for complaints needs overhauling.

Owing to the growing needs of the Defence Department in 1942, an extensive scheme estimated to cost 17 crores of rupees, of erecting telegraph and telephone channels was put in hand and is scheduled to be completed in 1944-45. The Department was called upon to manufacture communication equipment in very large quantities for the Armed Forces. Vast expansion of existing workshops was undertaken and a new workshop was established in Central India at a cost of over 30 lakhs of rupees. Even this was found insufficient and 91 other workshops large and small were employed in the manufacture of stores. The cost of these was Rs. 61,95,720 in 1938-39 and it rose to Rs. 48,346,000 in 1943-44.

The acquisition by the Department, of telephone systems owned by private companies at Calcutta, Bombay, Madras, Karachi and Ahmedabad is an event of considerable importance from the point of view of long-term planning and development. One can only hope that the red-tape associated with the Government machinery will not be allowed to impair the efficiency of service.

The Department is run on commercial basis and it is stated that the increased rates and surcharges are not a part of Department's financial policy but are aimed at raising revenue for the war effort. It is heartening to note that it is first and foremost a public utility service whose principle objectives are cheapness and efficiency. One would in this connection suggest the grant of a bonus to the workers out of the profits, or the introduction of co-operative principles in any other form so that the workers may feel that they stand to benefit both by economy and efficiency.

LETTERS TO THE EDITOR

THE *LIGHT-EFFECT* UNDER ELECTRICAL DISCHARGE: THE PROBABLE TIME-LAG IN ITS PRODUCTION

DISCOVERED originally[1] as a small increase, on irradiation, of V_m the 'threshold potential' required to initiate discharge at a given gas pressure, subsequent work has shown that the above influence is of wider occurrence and of a greater order of magnitude than a 'residual phenomenon'. It was shown[2] that i, the discharge current, depends chiefly on $V - V_m$ where V is the applied potential. From this it follows that under conditions, *e.g.*, irradiation which increase V_m, a diminution of current Δi, should occur. This prediction has been fulfilled in numerous cases without exception and is perhaps the simplest way of investigating the phenomenon.[3,4,5]

It was observed from the very beginning of this work, that whilst the start of Δi the light effect is practically instantaneous, its full value is attained only after an appreciable time, as shown by a sensitive ballistic galvanometer actuated by an A.C. rectifier or a vacuo-junction which carried i the discharge current. This remark applied also to the reverse change, *i.e.*, when i_l increased to its original value in dark on screening off the light. With improved knowledge of the chief determinants of this phenomenon, it has been possible to obtain Δi as high as 93 per cent.[5] Short period, dead beat type galvanometers could, therefore, be employed despite their comparative insensitivity. This reduced markedly the hitherto appreciable interval between the act of irradiation and observation of Δi to about 1-2 seconds. It is found, however, that the inertia of the galvanometer suspension and especially the heat conductivity of the vacuo-junction set a lower limit to the time in which Δi may be observed.

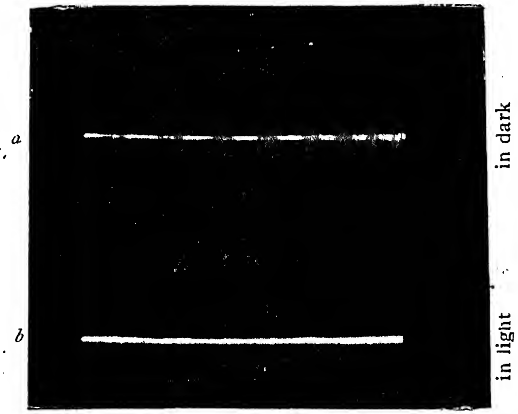


FIG. 1

Oscillograms of the discharge current

That any time-lag inherent in this effect may well be shorter than the above period was seen, when the mode of its observation was varied. The discharge current i was allowed to flow through an iron core transformer; its secondaries were connected to an amplifier and a loud-speaker. This produced a characteristic group of notes, when the chlorine tube, screened from light, was excited by

applying a suitable potential. The volume of this sound *decreased* sensibly and as far as could be judged, practically instantaneously on irradiation and *vice versa*.

This conclusion is supported by studies of the light-effect that were made with a cathode-ray oscillograph.[4] This was introduced in place of the loud-speaker in the previous arrangement. It is found that a large number of frequencies besides, and much higher than, that of the A.C. supply constitute *i*, the discharge current (Fig. 1*a*). The amplitudes of these frequencies are reduced to a very marked extent immediately on irradiation (Fig. 1*b*).[4] This reveals a significant factor in the mechanism of the light-effect. The change $a \underset{\text{dark}}{\overset{\text{light}}{\rightleftharpoons}} b$ is reversible; the corresponding period, *i.e.*, any time lag in its occurrence lies within the limits of visual persistence.

Chemistry Department,
Benares Hindu University, S. S. JOSHI.
September 17, 1944.

1. Joshi, *Curr. Sci.*, 1939, **8**, 548. 2. —, *Trans. Faraday Soc.*, 1927, **23**, 227; 1929, **25**, 108, 138. 3. —, *Presidential Address, Chem., Sec., Ind. Sci. Cong.*, **1943**. 4. —, *B.H.U. Journ.*, **1943**, **8**, 99. 5. —, and Deo, *Nature*, 1944, **153**, 434.

SPECTROSCOPIC INVESTIGATION OF THE EFFECT OF MAGNETIC FIELD ON ELECTRICAL DISCHARGE IN GASES

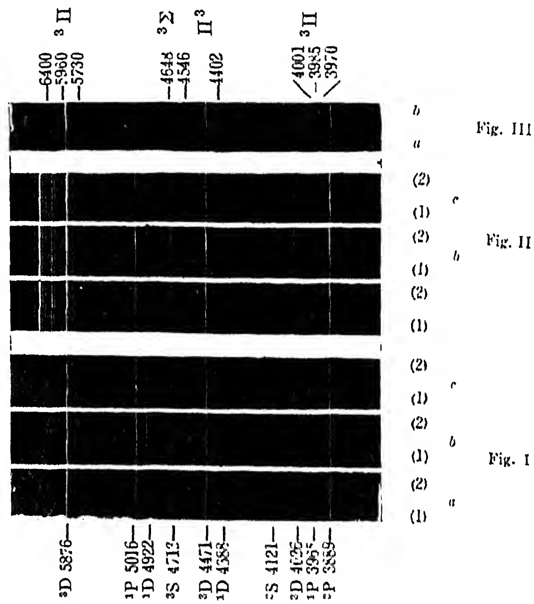
IN the Zeeman Effect experiment usually performed in the laboratory with a neon tube, it is observed that the magnetic field, besides producing the well-known splitting of the lines, affects to a marked extent the intensity of the glow in the discharge tube. It was thought that a detailed spectroscopic investigation of the effect of magnetic field on the variation in the intensity distribution amongst the spectral lines, would give useful information about the collision processes involved in the mechanism of discharge of electricity in rarefied gases. Preliminary experiments with helium, neon and hydrogen have revealed some interesting facts which are set forth in this note. The experiments were performed with the ordinary capillary discharge tubes placed between the poles of an electro-magnet capable of giving a field upto 10,000 gauss. The tubes were worked between 10 and 15 kilovolts. The results of observations may be summarised as follows:—

(*i*) The intensity of the lines increases with the magnetic field, reaches a maximum and then decreases, the decrease being more rapid than the increase. This is shown in Fig. 1 (*a*, *b*, *c*) in the spectrum of helium, where the lower strips (1) give the spectra in zero field, and the upper strips (2) in fields of 4,000, 6,200 and 7,800 gauss respectively.

(*ii*) The field at which a line reaches its maximum intensity, the conditions of pressure and excitation remaining the same, depends on two factors (*a*) the wave-length and (*b*) the presence of foreign gas.

The dependence on wave-length was best exhibited with the Balmer series of hydrogen. H_δ appeared as a weak line in zero field, reached a maximum intensity at 4,000 gauss, after which the intensity fell off rapidly and the line was not excited at all at higher fields. H_γ reached its maximum intensity at 6,000 gauss, whereas H_β and H_α showed a continuous increase in intensity even upto 10,000 gauss, the maximum field obtainable in the experiment.

The effect of foreign gas on the intensity of the lines is shown in Fig. 2 which gives the spectra of a mixture of helium and neon. In the three strips the lower halves marked (1) are for zero field, and the upper halved marked



(2) are for fields of strength 4,900, 7,000 and 8,200 gauss respectively. It is to be noted here that, in contrast with Fig. 1, the lines continuously increase in intensity without showing a maximum. The effect of the foreign neon gas seems to be to increase the field strength at which the helium lines will have their maximum intensity.

(*iii*) For a given applied potential at the terminals there is what may be called a "critical" field at which the discharge stops altogether and the tube becomes non-conducting. As this critical field is approached, and just before what may be called the "throbbing" state of the tube, the intensity in the capillary portion (which is kept in the magnetic field) is considerably reduced and the intensity of the glow in the wider portions of the tube, near the electrodes, is correspondingly increased. Fig. 3 is the spectrum of helium from the *wider portion* of the tube in this state (*a*) without the field and (*b*) with the field which under the conditions of the experiment, is found to be 6,200 gauss. It will be observed that without the field only the weak atomic spectrum is produced, while with the field on,

not only is the intensity of the atomic lines increased but the molecular spectrum of helium is fully brought out. The spectra from the wider portions of the tube for lower values of the field at the capillary, showed only the atomic lines. It is to be inferred that he excitation of the helium molecule bands is a sudden process occurring within a narrow range of field strength near about the "throbbing" field. Most of the He_2 bands are identified with the triplet electronic states, and they involve only the two lowest states $2p\pi^3\Pi_g$ and $2s\sigma^3\Sigma_u^+$.

I wish to express my grateful thanks to Dr. A. S. Ganesan for his kind guidance.

Physics Department,
College of Science,
Nagpur, S. B. KULKARNI.
September 26, 1944.

ELASTIC BEHAVIOUR OF METALS NEAR THE MELTING POINT

THE velocity of sound in metals in the solid state, just below the melting-point, is about twice as great as that of the liquid metal, just above the melting-point. Certain abnormal metals, however, such as bismuth, show an increase in velocity in the liquid state. The mathematical relation between the velocity of sound and elastic modulus for a solid and the coefficient of compressibility for a liquid are well known. They involve only the properties stated and the density. The abrupt change in the velocity of sound and the elastic properties, is explained on the basis of the harmonic model developed by Fowler and Guggenheim.[1]

It is well known that the frequency of vibration of atoms in the solid is dependent on the elastic constants. Considering an isotropic solid and assuming that the atoms are vibrating about mean fixed positions with a single frequency ν_K, it may be easily shown that the atomic frequency is proportional to $\frac{v_K}{\sigma_K}$ where v_K is the velocity of sound for longitudinal vibrations and σ_K is the mean molecular distance in the solid given by $\left(\frac{V_K}{N}\right)^{\frac{1}{3}}$, V_K being the molecular volume and N the Avogadro number.

Considering the liquid near the melting-point as an assemblage of a large number of linear harmonic oscillators, each vibrating with a frequency v_L about a slowly displaced equilibrium position it is easy to show that the frequency v_L is related to the velocity of sound by the relation

$$\nu_L = v_L \left(\frac{3N}{4\pi V_l}\right)^{\frac{1}{3}}.$$

The above model, although crude, has been applied to explain the viscosity of molten metals by Andrade[2] and surface tension by Sibaiya and Rama Rao[3] and thermal conductivity by Rama Rao.[4]

On the assumption that the densities of the molten and solid metal are the same at temperatures just above and below the melting-point, it follows that

$$\frac{\nu_K}{\nu_L} = \frac{v_K}{v_L} 0 \cdot 75 \qquad (1)$$

On the basis of the harmonic oscillator model for the liquid and the solid, the partial potential of liquid at ordinary pressure is given by

$$x_0{}^L = -x_0{}^L - 3k\,T \log \frac{kT}{h\nu_L} - kT + kT \log J^L\,(T)$$

where the superscript L refers to the liquid. For the solid the partial potential is given by

$$F^K = -x_0{}^K - 3k\,T \log \frac{kT}{h\nu^K} - kT \log J^K\,(T)$$

where the superscript k refers to the solid. Assuming that there is no discontinuity between the internal degrees of freedom in the solid and the liquid, the melting temperature temperature T_m is given by

$$\frac{x_0{}^K - x_0{}^L}{kT_m} = 3 \log \frac{\nu_K}{\nu_L} + 1$$

Denoting λ_m as the molecular heat of melting we obtain

$$\frac{\lambda_m}{T_m} = 3k \log \frac{\nu_K}{\nu_F} \qquad (2)$$

Hence combining 1 and 2 we have

$$\frac{v_K}{v_L} = \frac{4}{3}\, e^{\frac{\lambda m}{3kTm}} \qquad (3)$$

Table I gives the values of T_m, v_K and v_L as measured by Stierstadt[5] and the values compared with calculated results.

TABLE I

Metal	Velocity solid (Metres per sec.)	Velocity liquid (Metres per sec.)	T_m in °A	Ratio v_K/v_L	Ratio (Calc.) v_K/v_L
Cadmium	2665	1313	594	2·03	2·16
Mercury	2673	1290	234	2·07	2·10
Lead	1350	699	590	1·93	1·89
Tin	2643	1295	505	2·04	2·08

The agreement obtained between theory and experiment for normal metals is satisfactory. It shows that the lower velocity in the liquid is due to greater amplitude of the atomic oscillations and not to any extent to the irregularity of the arrangement of the atoms, as contrasted with their regular arrangement in the crystalline solid. On the basis of the above theory the decrease in the thermal conductivity of metals at the melting-point has been explained.[6] The formula also offers a method of calculating the compressibility of the molten metals from a knowledge of the elastic constants of the solid.

The elastic behaviour of solids at the melting-point and their relation to the crystal structure will be discussed in a separate note.

Bangalore, M. RAMA RAO.
August 31, 1944.

1. Fowler and Guggenheim, *Statistica Thermodynamics*, 1939. 2. Andrade, *Phil. Mag.*, 1934, **17**, 698. 3. Sibaiya and Rama Rao, *Ind. Jour. Phy.*, **1939**, **13**. 293. 4. Rama Rao, *Phy. Rev*, 1941, **59**, 212. 5. *Stierstadt Metallwirt Schaft*, 8th and 15th Feb. 1932. 6. Rama Rao, *Ind. Jour. Phy.*, 1942, **16**, 155.

A PHOTOELECTRIC METHOD FOR THE DETERMINATION OF THE AVERAGE DIAMETER OF FINE WIRES, FILAMENTS, FIBRES, ETC.

Theory

A BEAM of light of uniform intensity emerging from a rectangular slit is made to fall on a photoelectric cell producing a current i_1 which is accurately measured. Next, a parallel bunch of fine wires, filaments or fibres, which are opaque to the light, is interposed in the path of the beam. The current is reduced, depending upon the number and average diameter of the fibres, the new current after the interposition of the wires, fibres, etc., being i_2. If it is assumed that the current produced is proportional to the area of illumination, then it can be easily shown that the average diameter of the wires, filaments or fibres is given by the following formula:—

$$d = l/n \cdot \frac{i_1 - i_2}{i_1},$$

where l is the length of the slit and n the number of wires, fibres, etc., which may be counted either with the naked eye or with the help of a low-power microscope.

The two assumptions necessary for this formula are (1) that the wires, fibres, etc., are opaque to the light and (2) that there is not any appreciable overlapping. If the fibres are not originally opaque, it may be possible to render them opaque by dyeing. The condition for avoiding the overlapping may be satisfied either by mounting the fibres, filaments, wires, etc., individually, or by taking sufficient care in the process of parallisation to ensure that there is no appreciable overlapping. In actual practice it is possible to satisfy both these conditions in most cases.

Apparatus

An apparatus has been designed at the Technological Laboratory which satisfy the above-mentioned conditions and enables the diameter of fine wires, filaments or fibres to be measured quickly and accurately. Essentially it consists of a hollow cylinder which is supported on two uprights. An electric bulb is placed at one end of the cylinder, and the current in this bulb is maintained at constant level by means of a sliding rheostat. A condenser and diaphragms are provided to obtain a uniform beam of light which is made to pass through a water cell for the absorption of the heat rays. The light emerging from the water cell passes through a silt which is made exactly rectangular with great care, and the plate of this slit is provided with a suitable stand for holding a slide on which the fibres, filaments, wires, etc., may be mounted. These slides can be interchanged rapidly to enable a fairly large number of readings to be taken on the same or different materials. The photoelectric cell is held at the other end of the cylinder and the light passing through the slit with or without interposition of the fibres, wires and filaments falls upon the photoelectric cell and photoelectric current generated is measured with the help of a galvanometer with a shunt in the circuit.

In the preliminary study single fibres, fine wires of copper, silver, human hair, wool, artificial and natural silk, etc., were mounted individually, and the results of the average diameter obtained in this way were compared with those obtained by microscopic measurements. This method was found to give accurate results. Since, however, mounting of single fibres takes considerable time when as in the case of the textile fibres it may be necessary to examine a large number of them on account of their variability. in the later work relating to cotton fibres, a method has been developed in which a parallel bunch of fibers, which is first mercerised and dyed black, is mounted on a slide. The diameter measured in this way is found to agree fairly well with the microscopic measurement. In this way measurements have been mada on wires, fibres, etc., ranging from 20 to 120 microns and good agreement has always been obtained. This method is found to be simple, quick and accurate and has the additional advantage of giving the average diameter. This is particularly useful in measurements where a large number of fibres or filaments have to be examined for their diameter. Apart from fine wires and filaments, it may be used for fibres of wool, cotton, artificial silk, natural silk, etc.

A full account of the method, the apparatus, and the results will appear elsewhere.

Cotton Technological Laboratory,
Matunga, Bombay, NAZIR AHMAD.
June 26, 1944. R. L. N. IYENGAR.

ACTION OF SODIUM HYPOCHLORITE SOLUTIONS ON COTTON IN PRESENCE OF REDUCED VAT DYES

NABAR, Scholefield and Turner[1] have investigated the effect of reduced vat dyes on the hypochlorite oxidation of cellulose and have shown that an extraordinary increase in the intensity of oxidation occurs when a leuco-vat dye is present on the cellulose. They studied the reaction in greater detail using cotton yarn dyed with Cibanone Orange R[2] and showed that the amount of oxygen consumed was simply related to the various chemical properties such as cuprammonium fluidity, copper number, carboxylic acid groups, etc. of the oxidised cellulose. This behaviour could be attributed to the simplification in the mechanism of oxidation of cellulose. The striking feature of their results, however, was the constant ratio of 2 obtained between the aldehydic and carboxylic acid groups, formed in the products of oxidation which were prepared under different experimental conditions such as pH of the hypochlorite, concentration of the dyestuff on the fibre, etc.

With a view to investigate if similar behaviour is exhibited by other vat dyes, the work was extended to a few vat dyes including those susceptible to chemical modification or destruction. (Well-known example of a dye belonging to the latter category is Indanthrene Blue R which on treatment even with air or mild oxidising agents forms the greenish azine compound.) The chemical properties of the

cotton thus modified were found to show a simple relationship amongst themselves as was the case when the behaviour of Cibanone Orange R. In case of dyes such as Caledon Yellow G, Indanthrene Yellow FFRK, etc., which apparently did not appear to have undergone any modification with the hypochlorite treatment, the ratio between the -CHO groups and -COOH groups formed in the oxidised dyeing was found to be 2. On the other hand for dyes such as Indanthrene Blue R and Ciba Blue 2B which suffered modification as a result of the hypochlorite treatment, the above ratio was found to be 1. It appears, therefore, that the mode of oxidation of cellulose in these two cases is not exactly the same. The work is in progress.

Dept. of Chemical Technology,
The University, Bombay, S. H. MHATRE.
September 18, 1944. G. M. NABAR.

1. Nabar, Scholefield and Turner, *J. Soc. Dyers. Cols.*, **1935**, **51**, 5. 2. *Ibid.*, 1937, **53**, 5.

A NEW INDICATOR

AN aqueous extract of Hollyhock flower has been found useful as an indicator in acidimetry and alkalimetry. This indicator is superior to the generally used indicators, *viz.*, methyl orange and phenolphthalein as it can be employed for both weak acids and weak bases. Several varieties of this flower and also some other flowers belonging to the same family have been investigated. The colour of the aqueous extract varies being colourless, faintly green or dirty brown. It, however, changes in all cases to green colour with alkalis and to red colour with acids. The end point in the majority of cases is definite and in case of some flowers it is quite sharp.

The Hollyhock flower, the colour of which is brownish violet at the top and deep violet below towards the calyx region, yields better results. The extract is initially colourless and becomes faintly green in colour on standing. It has to be evaporated until the total solid content in it is about 2 per cent., when it is deep blue in colour and suitable for use as indicator. The titrations have been carried out using this indicator between standard solutions of approximately decinormal strength of hydrochloric acid, oxalic acid and acetic acid with sodium hydroxide, sodium carbonate and ammonium hydroxide, including those between weak acids and weak bases. Wherever possible the titrations have been carried out using other indicators for comparison. The results show an agreement within 0·1 c.c. with the expected readings. Taking the alkali in burette greatly adds to the ease and the accuracy with which the end-point can be determined.

Attempts are being made to analyse the extracts of these flowers in order to separate this indicator and to determine its composition.

Department of Chemistry,
D. A. V. College, D. S. DATAR.
Sholapur, D. R. KULKARNI.
September 7, 1944.

ORGANIC REAGENTS IN INORGANIC ANALYSIS

CUPFERRON or the ammonium-salt of nitrosophenylhydroxylamine, $C_6H_5.N(OH).NO.$, has been widely used for the estimation and separation of different metals. This compound has the following defects which, however, have considerably limited its applicability:—

1. The free nitroso compound is insoluble in water and easily affected by heat and light.
2. The precipitates formed are comparatively unstable towards heat and are also contaminated with the reagent and so direct weighing of the precipitates is not possible.
3. The reagent does not show any specificity towards any particular element or group of elements.

In order to improve upon these defects the following allied compounds are being examined:—

$R\cdot N(OH)\cdot CHO$, (1) $R\cdot N(OH)\cdot CO\cdot CH_3$, (2)

$R\cdot N(OH)\cdot CO\cdot R$, (3) $R\cdot N(OH)\cdot CO\cdot NH_2$, (4)

$R\cdot N(OH)\cdot CO\cdot NH\cdot R$, (5) $R\cdot N(OH)\cdot CS\cdot NH_2$, (6)

$R\cdot N(OH)\cdot CS\cdot NH\cdot R$, (7)

$R\cdot N(OH)\cdot CS\cdot NH\cdot CH_2\cdot CH{:}CH_2$, (8)

$R\cdot N(OH)\cdot CH{:}N\cdot R$, (9) $R\cdot N(OH)\cdot N{:}N\cdot R$ (10)

where $R = C_6H_5$. Compared to cupferron all these compounds and the precipitates formed by them with different metallic ions are comparatively stabler towards heat. Many of these reagents are soluble in water and form insoluble salts with comparatively smaller number of metallic ions. Copper has been estimated and separated from lead and mercury (*ic*) with (3). Titanium has also been estimated gravimetrically and separated from aluminium. Estimations of vanadium, molybdenum, tungsten and iron are in progress. Compound (6) is a versatile precipitating agent like cupferron but the precipitates are stabler and the reagent is enormously soluble in water, so that direct weighing of the precipitates is possible. Compound (7) unlike the parent substance (6) does not give precipitate with Ti^{++++} and Zr^{++++}, whereas the corresponding allyl compound (8) produces good precipitates only with a few elements, *e.g.*, Sn^{++}, Sn^{++++}, Hg^{+}, Hg^{++} and Ag^{+}. A change in pH of the reaction medium has been found to exert profound influence on the precipitating capacity of the reagents, thus increasing their specificity. The results of thorough examination of all the above-mentioned compounds in the form of full papers will be communicated shortly.

My best thanks are due to Sir J. C. Ghosh for his kind interest in the work.

Chemical Laboratory,
Indian Institute of Science,
Bangalore, S. C. SHOME.
September 25, 1944.

A PRELIMINARY NOTE ON THE AGE OF THE SALINE SERIES IN THE PUNJAB SALT RANGE

THE age of the Punjab Salt and its associated marl has been one of the most outstanding controversial problems of Indian geology.

Normally, in the Cis-Indus Range it lies below the known Cambrian beds; while in the Trans-Indus Range its normal position is below the known Tertiary limestones. Some geologists have assigned to the Saline Series the age according to their normal stratigraphical position, having postulated that the two salt deposits are widely different in age. Sir Edwin Pascoe in his memoir[1] has dealt with this subject very exhaustively and has concluded that the Cis-Indus and Trans-Indus salt deposits are of the same age, *viz.*, Tertiary, and that its anomalous position in the Cis-Indus range is due to an overthrust. But this view has been questioned by some of the present geologists of the Geological Survey of India with long experience of field-work in the Salt Range.

A. B. Wyne, one of the earliest authorities on the Salt Range, was in favour of Cambrian age of the Cis-Indus Saline series. In his pioneer work[2] he has stated "that every one who has examined the ground pronounces the salt marl unfossiliferous, but I am not aware that any of it has been subjected to microscopic examination". This view prevailed until recently and it is not known whether the rocks of the Saline series have been subjected to exhaustive microscopic examination in search of micro-fossils. Dr. B. Sahni of the Lucknow University has examined samples of marl and salt sent to him by me from the Warchha and Khewra Mines. The results of part of the work were published in the April 1944 number of *Nature* (p. 462). Most of the samples examined for microfossils have been found to be highly fossiliferous. That all the samples were collected from beds *in situ* either from within the salt seams or from beds immediately below the main seams has been guaranteed by me. It has, therefore, been established that the salt of the Cis-Indus Range is not of Cambrian or pre-Cambrian age but belongs to the Tertiary period.

This settles that the Cis-Indus and Trans-Indus salt deposits are of the same age. It has not yet been possible to determine the exact horizon of the Saline Series from a microscopic examination of the plant fossils. But it can be fixed very accurately because of the lithological similarity of the rocks of the Saline Series with the succession of beds in the Potwar plateau.

The Tertiary beds in the Fatehjang area in the Attock district, and as met with in boreholes of oil wells in the Khaur and Dhulian oil fields, have been classified by Mr. E. S. Pinfold.[3] The junction of the Murree series with the Eocene is unconformable and the basal part of the former is termed the 'Fatehjang zone'. Below this are the Nummulite beds termed 'passage beds' or 'A' beds. Underlying these are the purple shale beds with purple sandstone at top and these are termed 'B' beds. Below these is the fresh-water *Planorbis* Limestone and then the Hill Limestone (Laki and Ranikot), wherein petroleum is believed to have originated. From the stratigraphical position of the Rocksalt in the Trans-Indus Range at Kohat and from analogous petrological characters and the gypseous nature of the series in the Cis-Indus Range, there is little doubt that the Saline Series is identical with the 'B' beds in the oil series. As petroleum originated in the beds below the 'B' beds, the bituminous character and smell of oil in the Trans-Indus salt can easily be understood.

It has, therefore, been established that the age of the Saline Series in the Punjab Salt Range is Upper Eocene (Kirthar). It is hoped that Dr. B. Sahni will be able to confirm this by the isolation of definite forms of micro-organisms belonging to this horizon. It is worth mentioning that Purple Sandstone above the Saline Series which had been assigned a Cambrian age heretofore is associated with the Saline Series and there is little doubt that this is also of the same age as the Saline Series, *viz.*, Upper Eocene. Dr. Sahni may be able to confirm this as well by microscopic examination of these rocks, which have been so far pronounced to be unfossiliferous.

Mayo Salt Mines,
Khewra (Punjab), B. S. LAMBA.
August 15, 1944.

1. *Mem. G.S.I.*, 1920, **40**, part 3. 2. *Ibid.*, 1878, **14**. 3. Pinfold, E. S., "Structure and Stratigraphy of N.W. Punjab", *Rec. G.S.I.*, 1918, **49**, 137-60.

A STUDY OF *ACTINOCYCLINA LUCIFERA* AND *CALCARINA CALCITRAPOIDES* OCCURRING IN CALCAREOUS CLAY BED OF NUMMULITIC LIMESTONE SERIES, OF TADKESWAR, SURAT DISTRICT

Introductory.—The Nummulitic Limestone series belonging to Eocene period is well developed at Tadkeswar (21°-22′-30″ N. and 73°-4′ E.) about 9 miles east of Kim Railway Station.

General.—According to Wynne[1] and Blanford[2] the series is actually divided into ten distinct beds of limestone, calcareous clay, sandstone and conglomerate. Out of these only three beds, namely, Nummulitic limestone and calcareous clay with yellow boulder limestone are of any interest to a palæontologist.

Previous Workers.—Several geologists worked in the area, of whom Wynne,[1] Blanford,[2] Dr. J. Carter,[5] and S. R. Narayana Rao[4] have tried the palæontological side. The species belonging to genii Orbitooides and Calcarina are not mentioned so far by any of these workers—perhaps due to their microscopic nature which make it difficult to trace in the massive limestone. But if we make a detailed search in the residual calcareous clay overlying the massive Nummulitic limestone we find complete

small specimens of the above-mentioned species accompanied by other Nummulites, orbitoides, corals and even few Bryozoa.

1. Phyllum: Protozoa (Foraminifera).
   Genus: Orbitoides (D'orbigney).
   Sub-genus: Actinocyclina: Gumbel.
   Species: *A. Lucifera* (Kaufmann) Fig. 5.
   No. of specimen: Six, two broken.

Description.—Shell almost circular with a central mamelon surrounded by 16 to 18 prominent rays. Diameter of the test for one specimen is 4 mm., while for another it is 5 mm. Eight of the rays start from the centre, the others start at a distance of 1 mm. from the centre. The surface is uniformly finely granulated.

Remarks.—The fossil being very rare no sections were cut. Only from the outward appearance and by comparing with the figures of Nuttal[3] (Pl. 8, Figs. 7-8), and from description given there as described by Kaufmann, the specimen is compared with the species *Actinocyclina lucifera* which has 10 to 16 narrow rays on the surface and a diameter of 5 to 6 mm. The specimen differs from *A. alticostata* Sp. Nov. (Nuttal) of western Cutch and middle Kirthar in having more rays and lesser diameter.

Occurrence.—The specimens were found in the calc-clay overlying compact Orbitoidal limestone bearing Calcarina, Assilina, south-east of Tadkeswar.

2. Family: Rotalidæ.
   Genus: Calcarina (Zittel).[6]
   [Baculogypsina (Narayanrao)[4]]
   Species: *C. calcitrapoides* (Figs. 1, 2, 3, 4).
   No. of specimen: About 100, few others embedded in the massive rock.

Description.—Test vitreous perforate discoidal with dissimilar upper and lower surfaces; chambers spirally wound, clearly seen in thin sections. Spiral canal system present but no marginal cord. Exterior encrusted with granules which often resemble those of Discocyclina. These granules are over the supplemental skeleton which fills up all depressions and builds spiny or spur-like appendages traversed by coarse canals. The spine vary from two to eight in number. Complete specimen of eight spines are rare. Most perfect specimen are four-rayed with the rays in one plane at an angle of nearly 90°. In few specimen having five or six spiny rays the arrangement is not in one plane.

The spirally arranged chambers are often claw-shaped in a radius of 2 mm. Three whorls are most commonly seen. In all, chambers number up to 16 to 20. Maximum diameter of the shell including spines was 4 mm., length of the spine varies from ½ mm. to 1½ mm. Thickness of the shell varies from ½ mm. to 1 mm. Longest spine in a four-rayed shell is always opposite to the shortest. The spines are mostly conical attached to the shell at the broad end with fine canal system (seen under the microscope), which at their termination on the surface of the spine, give it a finely granulated ribbed appearance.

Remarks.—According to Narayanrao,[4] Baculogypsina which occurs in accompaniment of Pellatispira and Discocyclina, differs from the Pellatispira in having spinal canal-system and the absence of marginal cord. According to Mlle. Pfender, Pellatispira and Calcarina possess canal system. Pellatispira and Baculogypsina are correlated to the upper Eocene of Borneo.

S. R. Narayanrao[4] reports a similar form to *C. Calcitrapoides* (Photo Fig. 6, Pl. 2) but somehow names it "Baculogypsina". He does not give any species nor any description of the same except a few lines of its comparison with Pellatispira.

In Dr. Krantz's collection the slide *Calcarina calcitrapoides* from the Eocene beds of Holland resemble the sections in my slides in all respects. Zittel[6] gives a more ideal section for *Calcarina calcitrapoides* (Fig. 35); in *Elements de Palæontologie* (Fig. 8), Felix Bernard figures *Calcarina* (*Siderolina*) *calcitrapoides* LK (Mæstrichtien) which bears complete resemblance to specimens from Tadkeswar area.

External appearance gives the mistaken impression of a sponge (*e.g.*, Spongites, Astrophorous), or a Radiolaria but the absence of internal structure in both the latter clearly differentiates them from Calcarina.

Uptil now no text-book on Indian Geology refers to Calcarina to have occurred in the Surat Tertiaries due perhaps to its microscopic size which has made it unnoticed.

Occurrence.—The shell occurs in the calcareous clay overlying the compact Nummulitic limestone and accompanies Discocyclina. The forms are also associated with small Nummulites and Assilina although the genus Baculogypsina is, according to Narayanrao,[4] never found with them. The specimens were collected from the north-east of Tadkeswar and from the south-east near Bhankhurwari Nullan (Bhankhund Tadkeswar).

Age.—From the occurrence of the above two species in the upper parts of Nummulitic limestone series the particular horizon can be compared to the Yaw stage of Burma or lower Gaj Horizon of Sind.

Mr. S. R. Narayanrao bases his arguments in assigning upper Gaj Horizon (Burdigalian) to the Nummulitic limestone series, on the occurrence of Lepidocyclina, Baculogypsina and Pellatispira—the latter two being the same as Nuttal's Siderolites and Operculina from Kirthar series of Galla (six miles south of Tadkeswar) sent to Nuttal by Dr. T. W. Vaughan.

My thanks are due to Professor Dr. A. S. Kalapesi, for his kind guidance.

Bombay, HOMI R. BANA
September 25, 1944.

1. Wynne, "Geology of Gujrat", *Geological Survey of India Records*, **1 & 2**. 2. Blanford, "W. India Tertiaries", *Ibid.*, **5, 6, 8 & 32**. 3. Nuttal, "Foraminifera of W. India", **1926, 59**. 4. Narayanrao, S. R., *Curr. Sci.*, **1939, 8**; **1940, 9**. 5. Dr. Carter, *Geology of Western Gujrat*. 6. Carl Von Zittel, *Text-Book of Palæontology*.

NOTE ON A *PETALONEMA* FROM NORTH INDIA

An interesting blue-green alga closely resembling *Petalonema alatum* Berkley was collected in 1940 from near the Chakrata-Dehra Dun Road, at an altitude of 4,000-5,000 feet. This beautiful alga was found growing on small irrorated rocks. The alga occurred in the form of small expanded cushions of about ½-¾ of an inch thick and heavily impregnated with calcium carbonate. Inside the cushion, which in vertical sections shows zonations of growth (probably seasonal) the filaments are arranged more or less radially upwards. They vary in thickness, generally 40-90 μ broad, broader at the top and narrower towards the base. The cells are broader than long (8 μ long and 4 μ broad) in the younger parts and very much longer than broad in the older parts (10 μ long and 2 μ broad). Heterocysts are variable in form. False branches are generally single, but occasionally double. The branches bend upward and run parallel

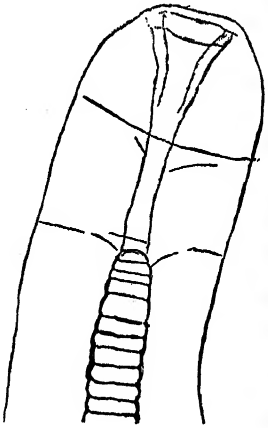


Fig. 1

Fig. 2

to the parent filament. The tip of the branch unlike in the type species is trumpet-shaped. Cells are constricted at the joints.

The trumpet-shaped tip of the filament (Figs. 1 and 2), the calcareous impregnation of the thallus and the radial arrangement of the filaments are among the chief features that distinguish the alga from the type species *P. alatum*. These points and the occurrence of the alga so far away from the type shows that it is probably a new variety of *P. alatum* for which the name *P. alatum* Berk. var. *indicum* var. nov. is suggested. As far as the writer is aware, the occurrence of either the type species or of this variety has not been reported from India previously. A fuller account of this alga is under preparation.

Diagnosis

Petalonema alatum Berk. var. *indicum* var. nov.

Thallus, expanded cushions ½-¾ inch thick, impregnated with lime and showing zonations of growth (probably seasonal). Filaments arranged more or less radially upwards, varying in thickness (40-90 μ broad) broader at the top and narrower at the base, cells broader than long (8 μ × 4 μ) near the tip of the branch and gradually decreasing in breadth and increasing in length (10 μ × 2 μ) lower down, constricted at the joints. Branching false, single or double; branches running parallel to parent filament; branch tip trumpet-shaped; heterocysts present and variable in form.

Habitat: On irrorated rocks (calcareous).
Locality: Near Chakrata-Dehra Dun Road.

Department of Botany,
University of Lucknow,
July 30, 1944.
A. R. Rao.

ON A NEW PLEROCERCOID FROM A SAND-FLY

The accidental discovery of plerocercoids in the fatty tissue of a sand-fly*† during routine examination of insect smears for bacteria is so interesting and unusual as to be worth recording. The first bunch of plerocercoids observed by us was in a slide stained according to a method perfected by Dr. S. Mahdihassan for the demonstration of bacteria in insect tumours. Since the very minute size of the sparagana precluded any study in the living condition, the same procedure was adopted to locate these forms in other smears also prior to re-staining with Heidenhain's iron alum hæmatoxylin.

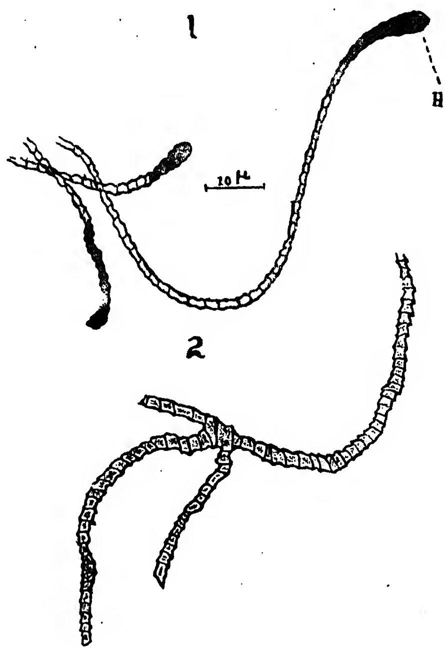
The insects are dissected under the binocular microscope and the fatty tissue of the abdomen, freed of the chitinous plates, is smeared on a well cleaned slide. While still wet, the slide is flooded with Bouin's fluid. After treatment for forty minutes with the fixative, the slide is washed successively with 50 and 70 per cent. alcohols and later rinsed well with tap water. It is then treated with a phosphate buffer of pH 7 for a few minutes and stained with a Giemsa solution prepared by adding 1 c.c. of the stock stain to every 25 c.c. of the buffer. The slide flooded with the stain is kept on a staining rack for an hour and after washing it well with tap water is treated for a few minutes with the buffer and then dried.

The dried stained smear presents a beautiful polychrome effect. The nuclei and the bacteria are of varying shades of pink, the ground cytoplasm blue and the cytoplasmic inclusions of mixed hues. The plerocercoids are lightly tinted pink. Those smears showing the sparagana were later stained with iron hæmatoxylin and mounted under a coverslip.

Two different stages of development were observed in the preparations. The first which appears to be an earlier stage occurs as a skein of threads. They are so thin that when lying close together in a row, ten of them

occupy less than 1·5 µ in width. No segmentation or a differentiated scolex could be observed in these tangled masses. However, they appear to branch, the branches and the main stems getting lost in the meshes of the skein.

The second stage shows distinct segmentation and we have a preparation of a clump of these plerocercoids in a mass of tissue showing not only branching but also a few scolices. The club-shaped scolex measures 10 to 20 µ



in length and this with the neck region following immediately appear deep blue, while the other regions are stained in varying shades of blue. The maximum width of the scolex (Fig. 1 H) varies from 4 to 7 µ while that of the neck varies from 1 to 2 µ. No bothridial grooves were observed in any of the specimens examined. In Fig. 2 is shown the mode of branching. The main stem as well as the buds show segmentation, but the segments themselves are of variable size, ranging from 3 to 5 µ in length and 3 to 6 µ in width. In Giemsa stained slides the central core of parenchyma is stained more deeply than that of the cortical region.

The presence of distinct segmentation raises the question whether the specimens described above could be considered larval stages at all? The absence of any indication of developing reproductive organs and the occurrence of the specimen itself in the fatty tissue of a sand-fly leads us to believe that it is only a peculiar larval stage of some Diphyllobothrid. Presence of segmentation in larvæ does not appear to be very peculiar for, Meggit[1] mentions that larvæ of *Schistocephalus* and *Urocystidium* show segmentation.

This is perhaps, the first record of a Sparaganum from insects. The previous records are all from fishes and other higher vertebrates and the only form showing branching is *Sparaganum proliferum* (Ijima, 1905) reported from the subcutaneous cysts of man (Ijima,[2] Yoshida[3]). The form described by us though apparently resembling *S. proliferum* differs from it (1) in its occurrence in the fatty tissue of a sand-fly and (2) by its possession of distinct segmentation. Precedent would probably justify the creation of a new genus to receive the above form, but we refrain from doing so because helminthological literature is already cluttered up with ill-defined species, which make identification a matter of considerable difficulty.

Hyderabad (Dn.),
October 5, 1944.

M. K. Subramaniam.
Mohan Babu Naidu.

---

1. Meggit, F. J., *The Cestodes of Mammals*, London, 1924. 2. Ijima I., *J. Coll. Sci., Imp. Univ., Tokyo*, 1905, **20**, 1–7. 3. Yoshida, S., *Parasitol.*, 1914, **7**, 219–225.

* We are very thankful to the Vice-Chancellor of the Osmania University for permission to work in Dr. Mahdihassan's laboratory; to Dr. Mahdihassan for his active interest and to Prof. B. K. Das for loan of books and journals. One of us (M. K. S.) would also like to thank Messrs. The Biochemical and Synthetic Products Ltd. for their encouragement.

† This sand-fly commonly occurs in marshy places in Hyderabad and belongs to the family Psychodidæ. A permanent mount of a bunch of these plerocercoids together with a few specimens of the sand-fly will shortly be deposited in the Indian Museum.

SOME OBSERVATIONS ON *MYCOBACTERIUM LEPRAE*

Is the degree of granularity of *Mycobacterium lepræ* constant in the various nodules? Does it rise and wane? Does it attain a peak in the oldest nodules? These are questions for which we have as yet no definite answer. In the light of Hoffmann[1] and Manalang's[2] suggestion that under treatment the rod-like bacilli become granular the above questions assume an added significance. Hansen's[3] original description itself contains records of rods and granules and many who claim to have cultured these bacilli (Lowenstein,[4] Salle,[5] Ota and Sato[6]) describe rods, "seed rows" or "string of pearls" and granules. Hoffmann considers that Hansen's bacillus produces "in its evolutionary cycle great numbers of granular forms which are found both within the bacilli and as free lying bodies". In the case of the tubercle bacillus Kahn and Nonidez[7] conclude that granule formation "is a type of segmentation rather than direct fission in which the rate of segmentation surpasses the ability of the elements to elongate". Marchoux[8] states that like Hansen's bacillus "the Stefansky bacillus may break up into granules". If the suggestion that the formation of granules is an essential phase in the life-cycle is accepted, then, how are we to distinguish these from

those formed by degeneration or disintegration as a result of treatment? It will be seen, therefore, how necessary it is to have an idea of the picture presented by young and old nodules in one and the same patient.

Very recently through the kindness of Dr. A. Shama Rao, Leprosy Officer to the Government of Hyderabad, I obtained smears and biopsy specimens from a lepromatous case which presented some peculiar features which are recorded below. Dr. Shama Rao's diagnosis is as follows:—"A. K., aged 30. Lepromatous case under treatment for the last ten years. He was an L_1 case but has now become L_2. He has nodules on the ears some of which are small and others big. A few are scattered on the body also. The face is infiltrated. There is no deformity of hands and feet and neural and acroteric symptoms are absent." On Sunday, 18-6-1944, a large nodule from the lobe of the right ear was removed and after making a few smears was fixed in Regaud's fluid. Again on Wednesday, 21-6-1944, a small nodule from the left ear was clipped and a few smears made. All the smears were stained in Ziehl-Neelsen and counterstained with Loffler's alkaline methylene blue.

In the smears made on Sunday from the large nodule, the following picture was observed. The bacilli in the globi are irregularly scattered, and those at the periphery have often a concentric arrangement. Though in most of the globi no stainable content other than the bacilli occur, yet in a few large ones where the clumped masses of bacilli occupy half or three-fourths the area of the globi only, the bacteria-free portion is stained by methylene blue and present a granular appearance. The walls of the globi are well defined and nuclei may be seen sticking to the walls. But whether these nuclei belong to the globi could not be made out from the smears. The smallest globi are less than 7 μ in size and are generally spherical. In the smear many empty spaces comparable to globi but devoid of bacilli could be seen. Since the outer limiting membrane of these clear spaces appears to be incomplete it seems as if these are globi which have got ruptured during the smearing process.

The bacilli in these globi are short rods, the longest of which is 5 μ long. But these long ones are rare as also granular forms. Very few—one in each field—of the long rods showed any beaded appearance. In one or two in each field there was just the suggestion of development of a bead at one end. In some regions the alignment of the short rods suggest as if they have separated from a beaded chain.

Typical "cigar packs" without any limiting membrane could be observed in various regions of the smear. These are always composed of long bacilli. From comparison with larger bundles all these long packs of bacilli could be arranged in a linear series. Single long bacilli lying free have lightly stained halos which do not completely envelope them. When two long rod-like bacilli lie side by side, they appear enclosed by the halo. In sc globi which present the typical 'cigar pa arrangement, one can see gradations fr long rods 7-8 μ long with a very faint s gestion of beading, to the smallest granu Rarely single rods taper to the ends, sometimes a beaded rod alone may be seen a clear vacuole.

In the smallest globi measuring 5-6 μ short rods have a peculiar arrangement. T form a regular row at the periphery, with one or two lying in the middle. Denney[1] scribes longitudinal splitting and branch but no such forms were found in the smea

Except in the larger globi, where the line of the globus stains deeper with met lene blue suggesting a definite membrane, the smaller forms there is no such unif differential staining. Often bacilli obser projecting into the blue stained cytoplas area suggest that the membrane is a l formation. Only careful study of serial tions would clarify this question. Irrespec of the size of the globi, the bacilli seen them differ in shape. Some are packed small rods and others with longer ones. majority of course belong to the former c gory and only one in fifty to the latter. in every hundred of these globi show arrar ment of short rods suggestive of the fact they may have belonged to chains. In others, the arrangement is very irregular.

In the smaller nodule from which the sn was made on Wednesday the appearance of bacilli is entirely different. About 90 cent. in any field are long beaded ones the other 10 per cent. being composed of rods without beads, short rods and granu Bacilli possessing from 2 to 8 beads could observed in any field and even the alignn of the short rods and granules suggest a they have just separated from chains. impression is accentuated by the fact that with variable number of beads and free nules or small rods aligned in the same lo tudinal plane could be seen in any field. of the globi are packed with these "seed rc which if carelessly stained give the impres of a clump of grains.

It would be seen from the above descrip that though the degree of granularity may said to be constant for a single nodule it is constant for all nodules in the same pa and neither does it reach a peak in the ol nodule. One is led to agree with Cowd that "though a single biopsy specimen exhibit marked granularity, this may or not be a favourable sign". When we cons that the patient has been under treatment ten years and when different nodules different pictures, the suggestion that u treatment the rod-like bacilli become segme and granular and that such an appear indicates a favourable prognosis appears t of questionable validity.

I am very thankful to the Vice-Chancello the Osmania University for permission to in Dr. S. Mahdihassan's laboratory, and Dr. Mahdihassan and Messrs. The Biochen

and Synthetic Products, Ltd., for their encouragement.

Hyderabad (Dn.),
July 21, 1944.
M. K. SUBRAMANIAM.

1. Hoffmann, W. H., *Internat. J. Leprosy*, 1933, **1**, 149–58. 2. Manalang, J., *Monthly Bull. Bur. of Health, Manila*, 1937, **17**, 3–17, 47–54. 3. Hansen, A., *Internat. J. Leprosy*, 1934, **2**, 476. 4. Lowenstein, E., *Ibid.*, 1935, **3**, 43–47. 5. Salle, A. J., *J. Infect. Dis.*, 1934, **54**, 347. 6. Ota M., and Sato, S., *Internat. J. Leprosy*, 1934, **2**, 175–93. 7. Kahn, M. C., and Nonidez, J. F., *Amer. Rev. Tuber.*, 1936, **34**, 361–82. 8. Marchoux, E., *Internat. J. Leprosy*, 1934, **2**, 89. 9. Denney, O. E., *Ibid.*, 1934, **2**, 275–78. 10. Cowdry, E. V., *Puerto Rico J. of Pub. Health and Trop. Med.*, 1938, pp. 95–117.

STORAGE OF POTATOES

IN your May issue (pp. 133-134) Dr. Khan A. Rahman described a method of preventing damage to stored potatoes by covering them with various materials, such as sand, chopped lantana, grass or soapnut leaves, pine needles, saw-dust or *bhusa*. The author claims that a problem which had baffled entomologists in India since 1907, yielded to his investigations and in the very first year of his work—in fact within three months, July-September—he obtained results which he describes "so striking and encouraging", that he has shown considerable anxiety to communicate his discovery to the Indian scientists. A moment's reflection, however, will show that there is nothing very extraordinary about these results. Briefly described the experiment was that Dr. Rahman placed 43 maunds of potatoes in a room, in 56 lots. Of these he covered 48 lots with various materials and left 8 lots, weighing a little less than 5 maunds, uncovered, *i.e.*, exposed. He then distributed 8 maunds of heavily infested potatoes, uniformly in the room, *i.e.*, introduced the pest. The only thing that could have happened was that the moths would lay eggs on the exposed food material of the caterpillars. And this is exactly what they did. This inevitable behaviour of moths hardly necessitated any experimental proof.

The difference in the percentage of attack between different "treatments" are insignificant. The striking differences between the control and experimental potatoes, simply show that the attack got concentrated or localised, on the exposed potatoes, and these, therefore, showed unusually high percentage of infestation. Unfortunately the author cannot claim this as a striking contribution to the solution of this problem. The practice of covering potatoes with sand is an old one and a very common one. Storage under sand has also shown variable results under different conditions. The problem of storing potato safe from potato moths and fungus diseases is not so simple as the article has made it out to be. On account of the intricate nature of the problem its detailed study has been undertaken in a scheme of the Imperial Council of Agricultural Research at Sabour.

In the experiments described by Dr. Khan A. Rahman the control was not designed scientifically and this has led the author to fallacious conclusions.

Department of Agriculture,
Bihar, Sabour,
August 28, 1944.
M. L. BHATIA.

NOTE ON THE SWARMING OF THE PLANKTONIC ALGÆ *TRICHODESMIUM ERYTHRAEUM* IN THE PAMBAN AREA AND ITS EFFECT ON THE FAUNA

ON page 404 of *Current Science*, Vol. 4, No. 10, dated October 1942, Mr. P. I. Chacko had reported an unusual phenomena of mortality of marine fauna including 750 Holothurians and 250 fishes, which occurred in the tide pool on the southern side of Krusadai Island in May 1942. He had attributed the cause to the fact that "the fishes were slowly asphyxiated by *Trichodesmium* obstruction before being washed ashore by the high tide".

A similar phenomenon was noticed this year on the southern coast of Pamban in the same month, when the following fishes and crabs were washed ashore dead: (1) *Gerres filamentosus*, (2) *G. abbreviatus*, (3) *Chanos chanos*, (4) *Mugil* spp., (5) *Saurus indicus*, (6) *Platycephalus insidiator*, (7) *Therapon janoua*, (8) *Sphyraena obtusata*, (9) *Lutjanus lioglossus*, (10) *Neptunus* spp., (11) *Gelasimus* spp.

Besides confirming the cause referred to by Mr. Chacko for the mortality, our recent observations showed that the mortality was also due to the putrefaction and pollution caused by the dead algæ. From 22-5-1944 onwards there was bright sunshine which was responsible for the swarming of the algæ in large patches by the acceleration of the photo-synthetic activity. On 25-5-44 when it was cloudy, the absence of sunlight, the thick layer of floating algæ and increase in temperature the water had caused the death of the algæ and polluted the waters causing the liberation of the offensive smell. So long as the algæ was in living condition, no casualty was observed. On 27-5-44 with the slight showers the dead algæ had settled down to the bottom and the "balance" in the water was restored. The clogging of the gills with the consequent asphyxiation and the related hydrological disturbances should have been supplemental factors for the heavy mortality of fishes.*

Krusadai Biological Station,
Gulf of Manaar,
August 15, 1944.
K. CHIDAMBARAM.
M. MUKUNDAN UNNY.

* With the kind permission of the Director of Industries and Commerce, Madras.

REVIEWS

Clowes and Coleman's Quantitative Analysis. (Fifteenth Edition.) Edited and Revised by Dr. Julius Grant. (J. and A. Churchill Ltd., London), 1944. Pp. viii + 557. Price 21/-.

This new edition of the well-known and popular text-book should be most welcome not only to all students of chemistry in the universities but also to some professional chemists who undertake a variety of miscellaneous analytical work. The material is presented in eight parts which describe respectively (1) General processes including physical determinations and analytical operations, (2) simple gravimetric determinations, (3) volumetric analysis, (4) miscellaneous methods of analysis, (5) applied quantitative analysis including (*a*) water analysis, (*b*) analysis of foodstuffs including beer, wines and spirits, sugar and tea, (*c*) examination of oils, fats and waxes, (6) general organic analysis, (7) gas analysis. The last part gives a most useful set of reference tables which include the results of typical analysis of materials of technical importance and tables of useful constants.

The scope of the book would certainly appear to be too large and ambitious for its size, but the author has succeeded in his attempt to present the entire material in a concise and clear manner. It is a pity, however, that there are some errors and misprints such as (1) "Without this reagent" for "with this reagent" in line 37 on p. 185; (2) "6 F^{++}" for "6Fe^{++}" on p. 285; (3) $Zn(NH_4)PO_4$ for $Mn(NH_4)PO_4$ on p. 75; (4) "potassium oxide" for "potassium iodide" in line 12, p. 288; (5) "potassium nitrate" for "potassium nitrite" in line 8, p. 73; (6) Na_2CrO_3 for Na_2CrO_4 in line 3 on p. 259.

The reviewer considers that the author has succeeded in producing a book to which "the student will turn for a reliable cross-section not only of the standard methods of analytical chemistry, but also of the modern trends of the subject". The book can be very heartily recommended for careful study by all students of chemistry in the University classes.

K. R. K.

The Application of Radiant Heat to Metal Finishing—A Critical Survey of the Infra-red Process for the Stoving of Paints and Enamels. By J. H. Nelson and H. Silman. (Chapman and Hall, London), 1944. Pp. vi + 79. Price 8/6.

Heating by radiation has been extensively used in industry, employing both gas and electricity as the heating media; but so far as paint baking in the metal finishing plant and processes are concerned, recent developments have been chiefly carried out by the electrical industries, making use of tungsten filament bulbs as source of radiation. The baking of enamels, particularly those of the synthetic type, is brought about by a polymerisation process which takes place at a temperature usually of the order of 250-350° F. For rapid baking it is important to bring the temperature up as quickly as possible and it is here that the advantages of heating by radiation become evident, as it is possible to convey a great deal of energy to the surface being heated with great rapidity and ease. Thus it is possible to cut down the drying time to a fifth or less of the time taken in the usual type of gas-heated convection ovens. This method of heating is more spectacularly referred to as "the infra-red process", although the precise nature of radiation has little or no influence on the phenomenon of paint drying.

The book under review deals with the fundamental principles of radiation plant design and since it is written mainly "from the standpoint of the user who is concerned with the installation of efficient metal-finishing plant", the last two chapters are devoted to paint formulation to meet the special characteristics of radiant heat process and to the fields of application of radiant heating.

When a receiver begins to rise in temperature, it starts also to lose heat by convection to the surrounding air. Thus although the air does not stop the radiant energy reaching the receiver, it will aid a very rapid loss of heat if due care is not taken, and thereby limit the rise of temperature. From considerations on these lines, it can be shown that radiant heating can best be applied to articles having relatively small heat capacity for their area, and requiring very rapid heating to a temperature not greatly in excess of their surroundings. Articles needing heating to a temperature very much above the surroundings are not suitable, unless radiators capable of large outputs are available. Radiant heating electric lamps up to 1000 watts, have been developed in U.S.A., the latest development being the "sealed beam" unit, with the bulb, reflector, and front dispersion lens all combined in one unit, with bi-post filament leads. More recently gas-fired radiant heating ovens have been developed in England, which combine simplicity and robustness with the advantage of very much higher energy densities. Chapters II to V deal with the principles of heat transfer and the design and construction of radiators, reflectors and ovens.

"It can be said with little fear of contradiction that for the baking of paints and enamels on most sheet-metal articles, the purely convection type of oven is obsolescent, though certain uses may prove economic owing to peculiarities of design. The whole field of industrial heating would seem to be open to radiant energy, though in a very large number of cases the simultaneous effects of conduction and convection will still be of equal importance". The book gives a balanced account of the present stage of development, and should be of great value to manufacturers and users alike.

M. A. G. RAU.

Industrial Planning for Post-War Mysore. By B. S. Narayana Rao, Civil Engineer, Tumkur, 1944. Pp. vi + 16. Price 8 As.

This apparently hastily printed and published brochure of 16 pages (4" × 6" size), with too many spelling and grammatical mistakes, could well be a carefully revised contribution to one of the various scientific and technical journals published in Mysore or outside it in India. It deals all too briefly with several local problems of transport, water supply, fuel, research and finance, and the possible distribution of future industrial undertakings in the State.

M. A. G.

The Indian Cotton Textile Industry (1943 Annual). Edited by Mr. M. P. Gandhi. (Published by Gandhi & Co., Bombay). Pp. 150. Price Rs. 4-4-0.

Mr. M. P. Gandhi deserves to be congratulated for bringing forth the Indian Cotton Textile Industry 1943 Annual with several improvements over its predecessors in spite of the cramping economies imposed by the war. The volume contains valuable and interesting information and statistical data relating to the developments of the industry from all aspects. In discussing the progress of the industry, the author pointedly draws the reader's attention to the post-war prospects and problems facing this premier national industry employing at present no less than 5 lakhs of operatives, over 5,000 University men, with a capital of 49 crores of rupees. A considerable portion of the book is devoted to chronicling the major events during 1943 in the sphere of textiles—particularly the various control orders affecting the industry, the working of the Textile Control Board, introduction of standard cloth, comprehensive price control and marketing of yarn and cloth, etc.,—all of which makes interesting and useful reading.

The book concludes with three appendices. The first one deals with cotton, its cultivation, import and export and the problems India has to face in the matter of short-stapled cotton in the light of the changing conditions in the industry both at home and abroad; the second with the handloom industry and the last gives a list of cotton mills in India. The chapter on the handloom industry is indeed a very informative and thoughtful contribution. The author has made copious extracts from the report of 'Fact Finding Committee (Handloom Mills)', appointed by the Government of India, whose report was published in 1943. With a wealth of revealing data, he has exhaustively discussed the various factors that have affected this age-old but grossly neglected industry and the remedial measures necessary to put it on a sound footing. Handloom industry is, next to agriculture, the largest single industry in the country employing nearly 2½ million men and maintains a population of about 10 millions. Although it may be said to enjoy a short spell of prosperity owing probably to the scarcity of cloth and the several control measures instituted by Government, the author has rightly stressed the Enquiry Committee's recommendation that apart from Government help and co-operative effort, it is necessary to run the industry on businesslike and commercial basis with the active association of businessmen of proved ability and character if it is to flourish and thereby help to revitalize rural life.

There is a short reference to the various minor industries ancillary to the Textile Industry—concerned in the manufacture of healds and reeds, bobbins, shuttles, starches, etc. Mr. Gandhi would do well to create greater consciousness through his publication with regard to the need for stabilising these industries and establishing heavier industries for manufacture of textile machinery.

B. G. R.

CARNEGIE INSTITUTE OF WASHINGTON*

THE travails of war have undoubtedly had far-reaching repercussions on normal life in every land, but it is refreshing to note that in keeping with American tradition, the march of time does not find scientific progress left behind. The publication under review, quite in keeping with national needs in times like the present, relates to the record of researches directed toward the prosecution of war.

The division of plant biology, headed by the physiologist, Spoehr, engaged itself in problems of ultimate utilitarian value. Starting on the premise that plants are the sources of basic food upon which mankind has to live, new avenues are sought for in this direction. In the past, the manufacture of food in the green leaves of land plants has been studied, and to-date, our knowledge of this complex process is fairly clear. Having in view other less-known plant-forms and materials which could likewise be used as probable sources of food, now somewhat naturally, research has been directed to the study of photosynthesis in members of plankton-flora, diatoms, brown and red algæ, dinoflagellates, yellow-green and the blue-green algæ, inclusive of one-celled colo- oil-yielding regions. A study of photosynthe- nail algæ. Fossil diatoms have given clues to sis in living ones reproducing under experimental conditions such as those that might have prevailed in former geological ages, throws light on geological formations of the earth.

The classical work of Warburg and Negelein on the one-celled green alga, *Chlorella*, has yielded great many secrets of photosynthesis before. Adopting like technique, twenty species of algæ, diatoms, less abundant Cryptophyceæ, dinoflagellates and blue-greens have been isolated, by micromethods, cultured, and details of photosynthesis studied in these.

By chromatographic adsorption analysis, pigments of Bacillarieæ, Xanthophyceæ, Dinophyceæ, Cryptophyceæ, members of Chlorophyceæ and Phæophyceæ, have been isolated, analysed

* Carnegie Institute of Washington, Year-Book No. 42, 1942-43. (Carnegie Institute of Washington, Washington, D.C.), 1944. Pp. 208.

and chemically studied; likewise, the influence of various factors on photosynthesis has been studied by modern methods. Over 24 plant pigments have been studied, and the majority of components of pigments of the green algæ appear to be identical with those of the higher plants, whereas pigments now studied in members of various groups cited above show wide structural and distributional differences. Based on chemical affinity between several of these pigments, a phylogenetic grouping is attempted.

The effect of various factors, of chemicals like potassium, nitrogen, phosphorus, and of light, on cultured *Chlorella pyrenoidea*, have been studied, and as an overall measure of synthetic activity, instead of assimilatory coefficient, R-values (*i.e.*, degree of reduction of Co_2) have been adopted. The authors claim that these R-values can be experimentally enhanced to 38–50 times the normal in this alga, whereas in green leaves it is not more than 30-40. This means, the food output can be increased. In this way, the experimental study of the modifiability of photosynthesis in pure cultures of these forms opens up new avenues of food sources, and will also lead to a more comprehensive understanding of photosynthesis in the entire plant kingdom than is available now. In that β-Carotene, a component of green pigment, is the precursor of vitamin A, these forms were studied for their sources of vitamin A and vitamin C and the results, tentative now, appear to be hopeful. No literature list accompanies these chapters.

Experimental Taxonomy

The ever-absorbing question of what is a species, its position as a unit in Biosystematics, its resolution by modern Cyto-genetic methods, the formation of various evolutionary patterns in normal sequence, the role of amphidiploidy in speciation and the ecological adaptability of these in geographic distribution—these are some of the engaging problems with which the section of experimental taxonomy occupied itself within the past year. Amphidiploidy in Madiinæ has been studied and agriculturally useful amphidiploids in *Phleum*, *Poa* and *Agropyron* have been raised.

Palæobotany (Dr. Chaney)

The discovery of fossil Cactaceæ and other succulents in mid-Eocene throws light on the origin of arid climate in Pliocene and this is of interest in the reconstruction of topography of early geological ages. A select literature list is appended.

Department of Genetics

The fact that the war effort of the nation did not make big demands on this department has not by one whit diminished the pursuit of pure research.

Warmke and Davidson continued their investigation on the cytology and breeding behaviour of the *Russian Dandelion*. Anatomical studies of the root revealed a definite and regular increase in latex percentage with increase in distance from the crown. The part of the root used in sampling was, therefore, found to be of great importance for breeding purpose. Artificially induced tetraploids showed the usual complex of gigas characters and efforts are being made to see if increas root-size is accompanied by increase in ru content.

The colossal expansion of industry in time has brought in its train new suffering humanity—one of which is the serious in to the human eye as a result of constant posure to ultra-violet radiation. Working tissue-cultures of neuroblast cells of the g hopper *Chortophaga viridifasciata*, Kaufr and Hollaender have found that exposur ultra-violet radiation of wave-length 2573 an intensity of about 3000 ergs per square per second for periods of only 5-10 min will arrest cell division for a conside length of time. Apparently dividing cells extremely sensitive to wave-length 25 which appears to cause a blocking of cel prophase. Ultra-violet radiation differs s ingly from the X-ray effect in the absenc a compensatory period after recovery.

Hollaender, Dmeerec and Sansome have tinued irradiation experiments with the fu *Neurospora*. The frequency of X-ray ind mutation increases approximately in propo to the dosage even when high dosages are ployed. Treatment with 126,000 roentgens duced about 75 per cent. mutations which i highest induced mutation rate on record. significant that 2650 Å, which is absorbed nucleic acid to a high degree is the w length most effective in producing mutati

Fano has shown interesting conclusions result of his experiments in which sperm *Drosophila* was treated with neutrons. frequency of association of lethals and arrangements appear to be much highe neutron-treated than in any other mat This is in keeping with the evidence neutrons as a rule produce fewer gene m tions and more chromosomal rearrangem than energetically similar doses of X-rays.

Through a study of the data on comple arrangements induced by X-rays Fano concl that the healing of potential breaks is i enced by mechanical stress that may be e ed through movement of the chromosc Potential breaks induced on exposure X-radiation in the mature sperm of *Droso* are not utilised in the formation of new c mosomal arrangements until after the s has entered the egg. Since irradiated n may be kept for several days before co tion, a considerable period of time is avai between radiation and fertilisation for ef to alter experimentally the recombination c city of broken ends of the sperm chromoso Such efforts involved exposure of the seminated females to incubator temperat of either 18° or 28° C., or to the heating ef of the near infra-red rays. Data assem indicates that both the near infra-red and temperature give percentages of altered spe It would seem that higher temperatures fa tate those chromosome movements which to the production of contacts between broken ends of the chromosomes.

In co-operation with Marinelli, Fano has vided a new calculation to the hypothesis large ion-clusters are responsible for X induced chromosomal breakage. This su

sedes the old idea that the absence of any wave-length effect in the genetic action of X-rays should be interpreted to mean that this action is produced by single ionisations or small ion-clusters, such as commonly occur along the paths of photo- or compton-electrons in tissue. Lea and Catcheside (Cambridge-England) used the same argument and calculated that clusters of approximately 20 ionisations ought to be the most effective in breaking chromosomes. Dr. Fano goes further and has calculated that 1 r of X-rays produces approximately 0·1 n clusters per cubic micron.

Mc Clintock has continued her investigations on the breakage and fusion of *Maize* chromosomes. She has evidence which suggests that the capacity for fusion of a recently broken end of a chromosome will be lost if this chromosome undergoes a division cycle before fusion with another such end has occurred. In the course of an attempt to determine the amount of crossing over that may occur within small segments, Mc Clintock found that relatively large amount of crossing over may occur between the loci of two mutants that are physically close to each other on the chromosome.

However hampered by conditions of war, the uniform excellence of researches in 1942-43, and the direction of these to new channels mark a distinctive feature of the work of this mighty institution. In common with former volumes, the get-up is good and presentation perfect.

K. V. S.

COUNCIL OF RESEARCH, UNIVERSITY OF TRAVANCORE

THE Thirteenth Report of the Vice-Chairman (Dr. K. L. Moudgill), Council of Research, University of Travancore, presented to a recent meeting of the Council, is, in the main, a factual summary of the progress of the several research schemes inaugurated under the auspices of the Council. It is not easy even to enumerate within the compass of a brief note the several problems which are under investigation. They cover an extremely wide range from the utilisation of the bitterns of the salt pans to the production of Agar-Agar, and of Titanium white from Ilmenite on the one hand, to a study of Teak defoliators, Gumkini, preparation of vaccines and Development of Fisheries on the other. The Laboratories of the Central Research Institute comprise of Public Health, Applied Biology, Applied Chemistry, Marine Biology and Observatory Sections. The work done in each of these sections is briefly indicated. It is obvious from even these necessarily brief summaries in this Report, that the Council has set before itself an ambitious programme planned with vision and enterprise. The very problems which have been given priority are indicative that Travancore, no less than other progressive communities, has not escaped the ferment which compels the attention of all thoughtful men to tomorrow and the brave new world to be brought into being after the war.

One is naturally tempted to project mentally some at least of these research schemes on to the larger canvas of the all-India research institutions and organisations. The retting of coconut work is a problem in which Travancore is not the only unit interested. Paddy problems are being tackled by the I.C.A.R. on a wider basis. Again, work on the collection and interpretation of meteorological data to serve even purely local needs could easily be made to be much more useful in conjunction with the all-India data. Conversely, the results or even the biproducts of the research carried out in Travancore might well prove to be of significant importance to people outside the State. An illustration, it makes sad reading in the Report, is that although the production of Agar-Agar was successfully initiated and developed by the Council to cover local needs, Travancore could supply but 55 lbs. against a demand of 150 lbs. by the Public Health Department of stricken Bengal. It must be added, however, that the Council have taken steps to avoid such a contingency in future.

It would be of interest and use to the other States and Provinces if the expenditure incurred by the Travancore Council of Research for investigations on so wide a front were given in this Report.

Dr. Moudgill's Report concludes with some very apposite observations on the provision of research and technical personnel to adequately cover the needs of post-war India. He takes note of the dismal possibility that even the facilities for training and research might have to be rationed on a quota basis—so great would be the disparity between supply and demand not only in India but also in Europe and America. He raises the very grave issue whether "formal courses leading to diplomas and degrees have their limitations" in training a technician, "no matter what his status—operative, foreman or leader". He undisguisedly frowns on "our present plethora of publicity, it has become the fashion for people to talk of schemes of research they sponsor and to judge the worth of people by the number of schemes of research they sponsor and the number of papers which they publish", and urges "that we should plan attunement of our personnel to our needs of the future". The wish that this part of the Report is brought to the notice of the much wider audience than the one Dr. Moudgill actually addressed does not imply that one necessarily agrees with all the premises and conclusions of the author. Dr. Moudgill concludes with quoting a Chinese proverb, "If you are planning for one year, grow paddy; if you are planning for fifteen years, grow trees; but if you are planning for a hundred years, grow men". *That* needed being said—*and* heard by all the planners.

SCIENCE NOTES AND NEWS

Writing in *The Times* under date 20th September 1944, Prof. A. V. Hill urges that one of the most pressing requirements of Indian Science, frankly recognised in India, will be of opportunities for higher study and research abroad for abler young people, future scientific leaders, who have been piling up during the war period. The same need exists in medicine, engineering, industry and many other fields. "In trying to meet it", Professor Hill adds, "we must help all we can, but it will not be easy to find spare places in our universities, hospitals and research establishments at a time when all our own young people will be returning from the war and I think we can rightly ask that, those who come here from India in the next few years of exigency, should be carefully selected before they start. Moreover, many of the ablest and most suitable people will be unable to bear the expense. It will be worth while for India to provide them with travelling bursaries or scholarships; the sterling balance is now so large that any possible expenditure of this kind will be completely insignificant, and it is difficult to imagine any better way of spending it."

Mr. John Sargent, Educational Adviser to the Central Advisory Board of Education of the Government of India, who is returning to India in October following a six weeks tour of American educational institutions, said in an interview to American journalists, that 2,000,000 teachers will be trained for post-war education in India and that extensive plans are now being made to provide many of these with special technological training in American colleges and universities.

"Our programme for post-war education in India has two great objectives—the solution of immediate practical problems and familiarizing our teachers with the culture, science and national character of countries other than our own. In both fields, we believe a period of education in the United States must play an important part."

Mr. Sargent listed the following as among the branches of technical study and research planned for Indian students who will be sent to the United States: Preservation of food, including freezing, canning and dehydration; distribution of food and other vital supplies; irrigation and hydro-electrics; aeronautical engineering and transportation. "My recent visit to great centres of technical training and research in the United States have further demonstrated the fact that America leads the world in these fields. We now are setting up a plan whereby Indian students with proper educational background and knowledge of English will be encouraged to take advantage of what the United States offers for the future of India.

"Our Central Advisory Board of Education purposes to correct the situation of the past whereby Indian students frequently lost much of the value of their study in the United States because they had not received the proper advice and guidance in advance. There is no record of an Indian student ever encountering an obstacle to his desire to study in the Unied States. Indeed, some Americans have expressed alarm at the extreme views of some of the young men and women we have sent over. We do not hope to insure that students who come to America not only are suplied with sufficient funds so that they will not be economically handicapped but that they are also possessed of good health and suitable educational background for the advanced work which they will undertake."

Mr. Sargent pointed out that since the beginning of the war there has accumulated in India a vast number of young men and women whose plans for overseas study had to be abandoned temporarily. In the post-war era—perhaps even before—it is expected the majority of these will leave India for study abroad. "We are most optimistic as regards prospects of our Executive Council granting approval of the plan we have prepared", Mr. Sargent concluded, "It appears they are agreed that India's great push forward after the war must be started by technicians. These technicians, we hope, will receive many of their ideas and much of their training either in the United States or from teachers who have been trained in the United States."

After receiving the medal of the Society of Chemical Industry at the Royal Institution on Friday, the 13th instant, Prof. A. V. Hill referred to his recent five months' visit to India and said the greatest need was for fuller use of science and scientific method, for this would have considerable effect on poverty from which India suffered. The first of India's scientific needs was to strengthen and expand education and research in biological sciences, in medicine and its associate subjects, in physiology and biochemistry, in genetics and all applications of biology to fisheries, agriculture, public health, pest control, animal and plant diseases and forestry. There must also be better facilities for teaching and research in physics, chemistry, metallurgy and engineering without which industrial prosperity could not be attained.

Sir Nelson Johnson, Director of the Meteorological Organisation in England, has arrived in India to study the working of the Meteorological Department of the Government of India and to suggest ways and means for its improvement and increased efficiency. Impending war operations in the Burma front demand increase in standard and efficiency and to attain this, the Government of India is stated to have felt the need for expert advice.

The Government of India have constituted the following Committee to examine the ques-

tion of Indian Fisheries with a view to increasing production of fish in India: The personnel includes Mr. Fazul Ibrahim Rahimtoola, C.I.E., (*Chairman*); the Hon. Nawab Khurshaid Ali Khan, M.B.E., Member, Council of State; the Director of Industries and Commerce, Madras; Mr. B. K. Dubash, of the International Fishing and Trading Co., Bombay; Mr. A. Karmally of Bombay; Mr. Jyotish Chandra Biswas of Calcutta; Pir Mohamed Haji Juman, Fish Merchant, Karachi; Dr. C. C. John of Trivandrum; Mr. S. Najmul Hassan, M.L.A., Bihar, Patna; Dr. Baini Prashad, Fisheries Development Adviser to the Government of India (*Secretary*).

A ten-year plan to increase coconut production (and thus stimulate the production of copra and coconut oil), by better treatment and manuring of plantations, is suggested in a report on the marketing of coconuts and coconut products by the Central Agricultural Marketing Department, Government of India. The administration of the plan, it is recommended, should be entrusted to an All-India Central Coconut Committee, which may give loans at cheap rates for manures and other improvements. The area under coconuts in India is about 1·5 million acres, producing annually about 3,000 million nuts. This, according to the Report, can be increased by intercultivation and manuring on a wide scale.

A meeting of the Plastics Research Committee of the Council of Scientific and Industrial Research was held in Bangalore on the 17th and 18th September 1944, Sir J. C. Ghosh presiding. The Committee recommended that every attempt should be made to manufacture in India the essential raw materials for the development of Plastics industry; phenol urea, phthalic anhydride, glycerine, furfurol, formaldehyde, poly-hydric alcohols, acetone, ethyl, butyl and amyl acetates, cellulose esters and ethers, constitute some of the principal ingredients. In the field of Plastics of natural origin, they consider that the following materials need closer investigation. Shellac, animal and vegetable proteins, rosins, vegetable oils, industrial wastes like horn waste, bagasse, coffee beans, seed-cakes, etc., and lignin.

The Committee reviewed the progress that had been already achieved and drew up a comprehensive scheme for future investigations. They have recommended to the Council of Scientific and Industrial Research that a Central Plastics Research Institute at a capital cost of 20 lakhs of rupees and a recurring annual expenditure of about 4 lakhs of rupees should be established in order that long-range problems relating to this industry may be pursued in a systematic manner. They feel, however, that the subject is so vast that original investigators outside the Central Research Institute should also be encouraged to carry out laboratory experiments on these subjects, but that large-scale pilot plant experiments on the basis of the results so obtained should be carried out in co-operation with experienced workers of the Central Plastics Research Institute.

The Government of India, it is understood, have given Rs. 156 lakhs as loan and Rs. 50 lakhs as grant to the provinces to produce vegetable seeds of European variety. The target has been fixed at 41,00,000 lbs. of seeds, with a view to making India independent of imported vegetable seeds.

In the course of his presidential address at the Annual Meeting of the Indian Sugar Mills' Association, Mr. Lalchand Hirachand declared that any plan of post-war reorganisation of the sugar industry must concentrate on reduction in manufacturing costs and explore the possibility of developing the cane. He pleaded for a rational utilisation of the bye-products of the sugar industry to bring about a reduction in prices. He visualised that the output of sugar would be doubled during the post-war period.

In the course of his reply to a Civic Address presented to him by the Madras Corporation on 22nd September 1944, Dr. Ambedkar revealed that under the scheme of technical training 68,000 men had been made into skilled workmen through 300-400 training centres, spread throughout India. "It is our hope and aspiration", he said, "that the scheme of technical training, which we have built up, will not be scrapped at the end of the war, but would become a part of the educational system of this country, whereby children of the working classes, who can have no opportunity of acquiring university education and obtaining academic degrees, will have an opportunity of improving their earning capacity."

Mr. John Sargent, the Indian Educational Commissioner, has arrived at Washington after touring the United States. He has completed a study of the American University methods to see whether they are applicable to Indian schools and arrange for exchange of professors and students.

The Sugar Technologists' Association has decided to nominate Sir T. S. Venkatraman as its representative on the Indian Central Sugarcane Committee of the Imperial Council of Agricultural Research.

It is understood that the C.P. Government have decided to appoint a Committee for industrial survey in the Province. It is also understood that the Committee will be expected to make a very rapid survey of the industrial resources of the Province and consider the possibility of establishing major and minor industries and make recommendations. The personnel and terms of reference will be announced shortly.

The President of the Columbia University, Dr. Nicholas Murray Butler, announced that a two-year survey of India's post-war needs will be conducted at the University under the direction of Dr. Krishanlal Shridharani, Indian scholar and writer. Mr. Butler said: "A comprehensive survey of proposals and plans for social and national reconstruction and reforms

in India will be made in an attempt to integrate them into a comprehensive policy. The findings will be embodied in an independent non-official report on India's needs and potentialities to be published under the title "Trends of Social Thinking and Planning in India". Mr. Butler said that Dr. Shridharani has been appointed Research Associate of the Columbia University and has already begun work on the new survey. The survey was made possible by a grant of th Watumull Foundation for Indian-American relations at Los Angeles. The survey will include an analysis of contemporary social thinking in India, a critique of social, religious and educational reform groups, plans for industrial development and expansion, Lend-Lease plans affecting India and examination of American proposals with respect to post-war reconstruction and financial aid.

To bring the Travancore University Labour Corps into line with the Officers' Training Corps in other Universities, it has been reorganized and renamed the "Travancore Univresity Officers' Training and Labour Corps". A course of study in Military Science extending over three years has been instituted from the beginning of the current academic year. Admission to the course is open only to Cadets in the Travancore University Officers' Training and Labour Corps. The syllabi are the same as those prescribed by the Government of India for Certificates "A" and "B" Examinations in Military Science.

Mr. C. R. Srinivasan, Editor, the *Swadesamitran*, Madras, delivered a course of four lectures on "The Press and the Public", under the auspices of the University.

Sir V. T. Krishnamachariar, K.C.I.E., formerly Dewan of Baroda, will address the next Convocation of this University to be held in November 1944.

The Government of India have invited a group of Indian industrialists and businessmen to visit England and America, as soon as war exigencies permit, with the object of studying the present industrial organisation of those countries, the technical advances made by them during the last few years, and their post-war industrial plans. The Mission will be unofficial in character, and its members, all Indians of independent views and position, will be free to arrange their programme and discuss any matter, unfettered by terms of reference or any form of Government control. They will be accompanied by their own technical advisers and will bear their own expenses throughout the trip.

Government will arrange facilities for them to visit industrial establishments and to contact leaders of industry and prominent businessmen in Britain and the United States. It is believed that the Mission's study on the spot of the latest developments in the industrial sphere, and the knowledge and ideas which they will bring back wih them will be of great value in the further industrialisation of the country after the war.

The Members will not be concerned with India's Sterling balances in London, or with any specific plan of post-war economic development.

The delegation includes Messrs. J. R. D. Tata, G. D. Birla, Nalini Ranjan Sarker, Sir Padampat Singhania, Mr. Krishnaraj Thackersey, Seth Kasturbhai Lalbhai, Sir Sultan Chinoy, Mr. M. A. Ispahani, Mir Laik Ali and Mr. A. D. Shroff.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory during the month of September 1944, there were three of slight and four of moderate intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin (I.S.T.)	Epicentral distance from Bombay	Co-ordinates of epicentre	Depth of focus
		H. M.	(Miles)		(Miles)
6	Slight	19 57	2690		
11	Moderate	16 16	3630		
14	Moderate	13 09	3110		
23	Moderate	18 43	4810		
27	Moderate	22 55	1345	Lat. 38°·0 N., Long. 81°·4 E., in Sin-Kiang, China.	
30	Slight	11 39	1395		
30	Slight	14 11	1440		

MAGNETIC NOTES

Magnetic conditions during September 1944 were slightly less disturbed than in the previous month. There were 19 *quiet* days, 10 days of *slight* disturbance and 1 day of *moderate* disturbance, as against 5 quiet days, 21 days of slight disturbance and 4 days of moderate disturbance during the same month last year.

The quietest day during the month was the 19th and the day of the largest disturbance the 30th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days: Slight	Disturbed days: Moderate
1, 3, 5, 7, 9–12, 15–19, 22, 25–29	2, 4, 6, 8, 13, 14, 20, 21, 23, 24	30

No magnetic storms occurred during the months of September in the years 1943 and 1944.

The mean character figure for the month of September 1944 was 0·40 as against 0·97 for September last year.

M. PANDURANGA RAO.

1230-44 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

CURRENT SCIENCE

Vol. XIII] NOVEMBER 1944 [No. 11

PRODUCER-GAS TRANSPORT

TO most people, the producer-gas plant on a motor vehicle generating the fuel to drive it, appears to be purely an engineering proposition. The fact that it is an apparatus whose successful operation depends on scientific design and technical control, based on investigations of a high academic order is usually overlooked.

This fact was clearly brought out at the first All-India Conference of Producer-Gas Technical and Testing Officers, called by War Transport Department in New Delhi from October 12th to 14th, 1944. The importance of this meeting was emphasised by the fact that the Honourable Member of His Excellency the Viceroy's Executive Council for War Transport gave the opening address and the sessions were presided over by Sir Kenneth Mitchell, Chief Controller of Road Transport and Development, the organisation being in the hands of Dr. H. B. Dunnicliff, Deputy Controller of Road Transport in charge of technical matters.

The outstanding points of Sir Edward Benthall's speech dealt with the magnitude of the problem and the urgent need for competent drivers to deal with this important branch of road transport representing, as it does, some thirty per cent. of civil buses and lorries on the roads of India at the present time. He appreciated the effort so far made but said that fifty per cent. conversion was the target. He informed the Conference that it was the intention of Government that many of the increasing number of chassis it was hoped to receive should swell the volume of civil road transport but that no promise could be given of a commensurate increase in the supply of petrol and that producer-gas was the only answer to the problem.

In pursuance of this objective he stressed the importance of the work of technical officers and the necessity for renewed endeavours to increase the production and distribution of charcoal suitable for this important purpose.

While questions dealing with the supply of materials and the control of the manufacture of plants, service garages, road tests and trials, competing types of plants and similar subjects would be expected in such an agenda, many of those present expressed appreciation of the high scientific plane on which many of the problems were discussed.

The firm determination of Government to see that engines of new controlled vehicles are not ruined by dust entrained in the gas is indicated by their insistence on a gas-purity test applied to all model plants by means of an apparatus costing well over a thousand pounds and of which six are in active operation at centres in various parts of India.

The scientific examination of the filter paper used in this test by Dr. L. C. Verman and his colleagues published in the November issue of the *Journal of Scientific and Industrial Research* and the paper on cotton cloths for gas filtration by the same authors which is expected to appear in the December issue of the same Journal, provide excellent examples of the use of accurate laboratory methods to advance industrial efficiency.

The resolutions passed by the Conference regarding the investigation of problems connected with the design and manufacture of producer-gas plants and their efficient opera-

tion and the acceptance of these principles by the Government of India was a welcome addition to the increasingly helpful attitude of official circles towards the co-ordination of scientific research with factory production. The Conference recommended that a standing Producer-Gas Research Committee should be formed without delay and action has already been taken to secure the co-operation of the Provincial and State Governments in which suitable laboratories and workshops exist.

Typical of the wide range of problems proposed were the investigation of improvements into top cylinder lubrication, the effect of the products of combustion on the engine lubricating oil and on the engine itself, the design of a standard producer-gas plant and the precise methods of packing filter units with such materials as sisal, cotton-waste or coir. In a different but equally important field were the contributions of the Forest Research Institute on the manufacture and properties of different qualities of charcoal carried out under the direction of Dr. Sri Krishna who suggested that the possibility of the manufacture at the Institute of a standard filter paper for the gas purity test should also be explored.

Great emphasis was laid on the ultimate dependence of successful producer-gas transport on the efficiency of the drivers and the necessity for the immediate organisation of properly equipped training schools for them all over India and the possibility of travelling teaching units for this purpose was not overlooked. The Conference also resolved that an adequate staff of technical inspectors, trained in the practical aspects of the use of this alternative fuel, was necessary in all Provinces so that the care and maintenance of gas-operated veheicles would receive adequate supervision.

A detailed report on this Conference, with appendices comprising papers subscribed by delegates and covering the wide range of subjects discussed, is in preparation and it is contemplated that the information in this brochure will materially assist this indigenous industry and those who use charcoal-gas lorries or buses. It is hoped that the constructive recommendations which have been made will result in the establishment of still more reliable producer-gas transport on the roads of this great country, not only at the present time, when the strain of war has forced it into prominence, but also in the post-war period of reconstruction and development, when it is the ambition of enthusiasts that producer-gas transport will prove that it has come to stay.

The full report on this important Conference will be awaited with great interest in Indian scientific and industrial circles.

D. D. T.

DICHLOR-Diphenyl-Trichlorethane (D. D. T.) was originally synthesised by Othamar Zeidler in 1874 and its physiological and pharmacological properties remained unknown till this important chemical was rediscovered by Paul Muller of the U.S.A. Department of Agriculture. But Frey of Cincinnati Chemical Works, U.S.A., solved the problem of its production on a commercial scale. The Americans consider it one of the most important discoveries of World War II and truly this insecticide can be termed as such. Paul Muller found that it killed bugs and it was first tested in 1939 during the plague of potatoes where it killed all the beetles. In 1943 it was used in Naples where it stopped the epidemic of Typhus. The matter must have been of very considerable importance that the Prime Minister Churchill made a special mention of D.D.T. in his latest review of war before the House of Commons. D.D.T. promises to wipe out mosquito and malaria and to destroy household pests such as cockroaches and bedbugs, and to control some of the most damaging insects. Lt.-Col. Ahnfeldt, of U.S. Surgeon-General's Office, considers that D.D.T. will be to preventive medicine what Listers' discovery of antiseptics was to surgery.

The use of D.D.T. as delousing agent against Typhus has been an open secret in America for several months. But in June last for the first time its manufacturers and Army, Agriculture and W.P.B. Officials announced some of its amazing properties:—(1) If sprayed on a wall it kills any fly that touches the wall for as long as three months afterwards; (2) a bed sprayed with D.D.T. remains deadly to bedbugs for 300 days; (3) clothing dusted with it is safe from lice for a month, even after eight laundrings; (4) a few ounces dropped in a swamp kills all mosquito larvæ; (5) it is deadly to household pests such as moths, cockroaches, termites and dog's fleas; (6) as a crop protector, it is deadlier and longer lasting than other insecticides. It has been found effective against potato beetles, cabbage worms, Japanese beetles, fruit worms against which other insecticides have proved to be failures.

U.S.A. has a very big programme in hand for its production but all for the army. D.D.T. owes its deadliness both as a contact and a stomach poison. It first paralyses hind legs of an insect and finally brings complete paralysis and death. It is remarkable that pure chemical has little effect. It is used in an oil solution or mixed with an inert powder. The usual dose is 1-5 per cent. D.D.T. It is non-toxic to human beings in the concentration which is used.

For the first time it was synthesised in the Government Industrial Laboratory at Hyderabad-Deccan, and a programme for producing it on a larger scale has been undertaken.

Rh, rh. Hr AND SOMATIC MANIFESTATION OF A RECESSIVE CHARACTER IN THE PRESENCE OF THE DOMINANT CHARACTER

By S. D. S. GREVAL
(*Laboratory of the Imperial Serologist, Calcutta*)

Rh and rh

THE new constituent of the human rbc (red blood corpuscle|corpuscles) has been described previously in this *Journal* (Greval, 1943). It is the normal constituent of the rbc of the common brown monkey of India, *Macacus rhesus*. Rh is obtained by detaching two letters from the beginning of the specific name and capitalising the first letter.

In the human rbc the substance Rh is absent from a small percentage of subjects. Like O-A-B and M-N it has a racial distribution: white Americans, 85 per cent. Rh+ and 15 per cent. Rh− (Landsteiner and Wiener, 1940); Red Indians 99·2 per cent. Rh+ and 0·8 Rh− (Landsteiner, Wiener and Matson, 1942); Negroes 89·8* per cent. Rh+ and 9·1 per cent. Rh− (Wiener, Sonn and Belkin, 1943); Calcutta Indians 90 per cent. Rh+ and 10 per cent. Rh− (Greval and Roy Choudhury, 1943; Das Guta, 1944).

The genetic constitution of the Rh+ and Rh− subjects was quite simple three years ago: there were two allelomorphs, the dominant Rh and the recessive rh. The positive, phenotype Rh, comprised genotype RhRh and genotype Rhrh whilst the negative, phenotype rh, comprised, of course, genotype rhrh only.

Things have moved very fast during the last two years. Now there are six allelomorphs, Rh, Rh_1, Rh_2, Rh′, Rh″, and rh (Wiener, Sonn and Belkin, 1944).

Anti Hr and St. Sera

Human sera have been found which coming from Rh+ mothers agglutinate the rbc of Rh− subjects and *also of some Rh+ subjects* (McCall, Race and Taylor, 1944). The latter have been proved by a study of the bloods of the family to be Rhrh in genotype. In these positive reactions an anti-substance prepared against rh carrying rbc is acting on rh carrying rbc as expected and also on Rhrh carrying rbc: there is no objection immunologically. Genetically, however, rh should not exist alongside Rh in the rbc. It should only exist on a special spot on the chromosome. Its existence elsewhere establishes the *somatic manifestation of a recessive character in the presence of the dominant character* against the definition of dominance and recessiveness.

Another example of the recessive character existing alongside a dominant character in a locality other than the chromosome also occurs in the human rbc. Certain abnormal human sera agglutinate rbc O and also rbc A, which are 'mostly heterozygous (of genotype A.R.)' (Wiener, 1934). R = Recessive = O.

Histologically the human rbc, like the mammalian rbc in general, are different from other animal cells in not possessing a nucleus and, therefore, chromosomes. Is the physical basis of the recessive character distributed in the general mass of the rbc and, therefore, free to react immunologically?

Alternatively a scrutiny of reactions of the abnormal anti-O sera and the anti-Hr and St. sera is indicated, in view of the fact that the first item is now rather old and in need of re-examination, and the second and third are too recent to be regarded as established facts.

* Rare types of Rh probably not determined. (S.D.S.G.)

Das Gupta, C. R., *Ind. Med. Gaz.*, 1944, **79**, 372. Greval, S. D. S., *Current Science*, 1943. **12**, 222. Greval, S. D. S., and Roy Chowdhury, A. B., *Jour. I.M.A.*, 1943, **13**, 65. Landsteiner. K., and Wiener, A. S., *Proc. Soc. Exp. Biol. and Med.*, 1940, **43**, 223. Landsteiner, K., Wiener A. S., and Matson, G. A., *Jour. Exp. Med.*, 1942, **76**, 73. McCall, A. J., Race, R. R., and Taylor, G L., *Lancet*, Feb. 1944, **12**, 214. Wiener, A. S., *Blood Groups and Blood Transfusions*. Bailliere, Tindall and Cox, London, 1934, p. 112. Wiener, A. S., Sonn, E. B., and Belkin, R. B., *Proc. Soc. Exp. Biol. and Med.*, 1943 **54**, 238. Wiener, A. S., Sonn, E. B. and Belkin, R. B., *Jour. Exp. Med.*, 1944, **79**, 235.

MARFANIL—SECOND TO PENICILLIN

IN North Africa the Germans carried among their medicinal supplies a sulphonamide preparation called Marfanil. This compound, chemically 4-amino-methyl-benzene sulphonamide, was administered neat or in tablets containing 50 per cent. of marfanil and 50 per cent. of sulphanilamide. Tests made with captured marfanil were recently described in the *Lancet* by G. A. C. Mitchel, W. S. Rees and C. N. Robinson (May 13, p. 627), who rank the drug as second only to Penicillin. "Of the many substances we have tested in the treatment of infected wounds penicillin alone has given better results than marfanil", they comment. "At present for technical reasons it may prove easier to produce marfanil in much larger amounts than penicillin and thus, even although the former is less effective, further investigation of marfanil is indicated. It is possible also that penicillin used in conjunction with marfanil may give better results than when it is mixed with sulphanilamide or sulphathiazole." Marfanil remains active in the presence of pus. Professor A. Fleming, who has investigated it, finds that it is a much weaker bacteriostatic agent than sulphathiazole (against a certain streptococcus) but is not inhibited by p-aminobenzoic acid or pus.

(*Discovery*, June 1944, p. 190.)

ROLE OF DOMESTIC ANIMALS IN THE SPREAD OF HELMINTHIC INFECTIONS IN MAN

By GOBIND SINGH THAPAR, M.Sc., Ph.D. (Lond.)
(*Lucknow University*)

ANIMALS have long been associated with man and their domestication has naturally led to the transmission of their diseases. These diseases thus transmitted are due to the bacteria, protozoa, worms or insects, but the present article aims at dealing with only such cases of infections to man as are caused by the presence of helminth parasites of domestic animals with particular reference to Indian conditions.

Helminths, like *Ancylostoma duodenale*, *Enterobius vermicularis*, *Wuchereria bancrofti*, *Schistosoma hœmatobium*, *Schistosoma mansoni*, *Tœnia solium* and *Tœnia saginata*, are exclusively human in their habitat, but there are a majority of helminths that man shares with the lower animals living in association with him. As an instance of helminthic infection from one animal to another we could mention the invasion of the kangaroo by *Fasciola hepatica* of sheep caused by the introduction of the latter into Australia. Similar infections may have occurred in man from animals and *vice versa*, due evidently to their association with each other. Thus, human *Ascaris* and *Necator* have been reported also from pigs in various parts of the world. It would, however, be interesting to note that in spite of the close association of horse with man from times immemorial, none of the parasites of horse has ever been found in man and *vice versa*, and this immunity according to Leiper, appears to be of an eternal nature. No systematic survey of helminthic infections in man has been carried out in India, but from the meagre available data the following points would be of interest in stimulating further work in this field.

A certain number of these parasites may pass their adult stage as commonly in man as in domesticated animals while others pass their adult stage in man and larval stages in animals or sometimes *vice versa*. Hence, in dealing with the subject we may conveniently discuss it under three categories.

I. *Helminths living as adults, both in man and animals.* Some helminths normally found in man may frequently occur also in animals; some other parasites are rarely found in man and hence are obviously "accidental".

Diphyllobothrium latum which is a normal parasite of man is found to occur in carnivores as well and is cosmopolitan in distribution. The eggs are passed out with the fæces into water where in due course they hatch. The larvæ are swallowed by minute water-fleas (*Diaptomus oregonensis*) in which they undergo some development until the flea is swallowed by a fish. The infective stage is attained in the fish and if the fish is eaten raw or in an improperly cooked condition development is completed in man. The parasite causes anæmia in man showing marked eosinophilia. The plerocercoid of another species of *Diphyllobothrium* has been said to occur in the Far East and it develops into an adult in the dog, cat and other carnivores. The adult proglottides have recently been recovered by us from cats in Silchar (Assam).

Another instance under this head is that of *Trichiuris trichiuris* which occurs both in man and in pigs, but is nowhere serious. Again, *Hymenolepis nana* occurs commonly in man and in rats and mice in India and elsewhere and has been recovered at Lucknow on several occasions.

Of the abnormal parasites, many are of sufficient frequency to enable us to regard animals as reservoir hosts. Thus, *Paragonimus* species are normally found in the lungs of mink, but they also occur in musk-rat, dog, cat, pig, goat and man. The eggs are coughed up into the mouth and then pass down the intestine and out to the exterior with fæces. They hatch out in about three weeks and enter the operculate snail, *Pomatiopsis lapidaria*. A large number of cercariæ emerge out of the snails and infect the crayfish where they encyst in the musculature. Infection occurs by eating crayfish in an uncooked condition when the young flukes penetrate the intestine and migrate directly to the lungs. No case of human infection is reported from India.

The liverflukes usually found in man and in carnivorous hosts belong to the family *Opisthorchiidœ*. It includes the genera, *Opisthorchis* and *Clonorchis*. They are carried by fish and are common in certain Eastern countries. Cases have been reported of *Clonorchis* infection in Calcutta. Besides the usual snail intermediary the Cercariæ encyst in the scales or flesh of fish which serves as second intermediate host and thus they are transmitted to man in the same way as *diphyllabothrium* or *Paragonimus* infections. A heavy infection causes progressive weakness, emaciation and anæmia. Man owes freedom from fluke infection to cooking, as heat quickly destroys the cysts and hence the fluke infection is not very common in human beings. But it must be admitted that very little search has yet been made for it in this country.

Diphylidium caninum is prevalent in dogs and cats, but it also occurs in children, the intermediate stage being found in fleas and dog-lice that may be accidentally swallowed by children playing about with dogs. Children also become infected with Ascarid worms of dogs and cats, producing infection through swallowing embryonated eggs. It may imply fæcal contamination of food and of utensils. Khalil (1926) has indicated the viability of *Ascaris* eggs even under high temperature and this indicates the necessity of extreme hygienic precautions in the prevention of such infections.

Trichostrongylus is a parasite of domestic animals but there are records of its occurrence

in man. A systematic examination may reveal the frequency of its occurrence in man.

Onchocerciasis of cattle, under suitable examination has been revealed to occur in man in Gautemala. The infection in man is caused by the Simulium flies and it has been shown not only to be the cause of tumours and dermal lesions of the face but may at times affect even the loss of vision.

II. *Helminths which occur as adults in man but as larvæ in animals.* Under this head, we consider first of all tapeworm infections. *Tœnia solium* and *Tœnia saginata* are both exclusively human parasites in their adult condition. Both these species were at one time confused with each other, so much so that many of the older workers regarded *Tœnia saginata* as an old and decayed specimen of *Tœnia solium* in which hooks on the rostellum had fallen off, as a consequence of old age. Leuckart definitely demonstrated them to be two distinct species, that are distinguished by the character of the Scolex—by the possession of the typical double row of hooks on the scolex of *Tœnia solium,* while *Tœnia saginata* is a hookless form from its birth. The larval form of *Tœnia solium* occurs in pigs (*Cysticercus cellulosœ*), while that of *T. saginata* is found in the cattle (*Cysticercus bovis*). It may, however, be mentioned that *Cysticercus cellulosœ* occurs abnormally in other animals including man. Maplestone and Bhaduri (1937) have summarised all cases of its occurrence in man in India from the available literature at their disposal. Occasionally *Cysticercus cellulosœ* gets into the brain of man, thereby causing lunacy. It is thus a dangerous infection and a number of such cases have been reported.

Mention may also be made of the occurrence of *Bertiella studeri* as an accidental and rare parasite of man, and cases are recorded by Maplestone (1933) and Maplestone and Riddle (1936) in Bengal.

The next important parasite is the Trichina worm, *Trichinella spiralis,* causing Trichinosis in man. The infection in this case depends entirely upon the habits of the people in eating pork. Where raw, uncooked or smoked pork is customarily eaten, its infection is to be feared. In the United States of America alone about 2,000 human cases have been reported. Generally the disease is chronic in pigs and there may be no symptoms at all and the flesh is unchanged macroscopically We need not discuss the course of the disease in man, but it would be interesting to know the frequent diagnosis of typhoid fever or ptomain poisoning in the acute cases and rheumatism in the subacute later stages of Trichinosis. The cases are traceable to the consumption of raw sausages or ham. Like most parasitic infections, here also there is observed in earlier stages considerable eosinophilia. It is stated that they are generally parasites of carnivores. Recently larval stages encysted in the muscles of squirrel have been recovered at Lucknow and they may possibly occur at other places.

III. *Helminths that occur as adults in animals but as larvœ in man.* Such cases are accidental. Mention may be made in this connection of 'Hydatid' cysts, cysticercus, "Cercarial dermatitis, hookworm and other larvæ causing 'creeping diseases'.

The adult *Echinococcus granulosus* lives in carnivorous animals. The intermediate hosts are quite numerous, in fact, any mammal may harbour the hydatid cyst. Sheep are most often infected but horses, pigs and wild ruminants are also important sources of infections. The disease is prevalent in pastoral countries where sheep serves as a reservoir of infection to dogs and thus the chances of human infection increase. Recently it has been found that the disease is prevalent in man in India, where several casses, originally reecorded as tumours, have, on re-examination, been reported by Mahadevan (1933) to be those of hydatid cysts. Maplestone (1933) concludes that cases of hydatid in man are perhaps commoner than is indicated by its record in medical literature. Drinking water has been said to be the common source of infection but it must be mentioned that the eggs of *Echinococcus* do not float in water but sink at the bottom. Hence this may not be a source of danger. The disease is usually contracted through contact with dogs. Children during play acquire dried eggs on the hands from dog's coating. Fæcal contamination of foodstuffs, particularly vegetables, is also a probable source of infection. Washing of hands before cooking or eating food would diminish the infection.

Cercarial Dermatitis is a disease caused by the skin penetration of the infective stages of a number of trematode larvæ. The *Schistosomes* are the most important of such infections. Whether they are in normal host or not, they cause a pronounced reaction at the seat of entry and the name "cercarial dermatitis" has been given to the resulting lesions. The entrance or infection results in a prickly sensation and urticarial blotches quickly develop round the seat of entry. Fortunately no case of such infections is reported so far from India but recently I have examined the urine of a patient at a Lucknow hospital harbouring eggs of *Schistosoma hœmatobium.* The case is an imported one and unless it is properly disposed of, it is feared that the disease may take up a serious shape in this country owing to the presence of the snail intermediaries like *Indoplanorbis* species.

Allied to this, there is the condition called creeping eruptions, in which a variety of parasites of lower animals penetrate the skin of man and finding the environment unsuitable, move about in or under the skin. Chief amongst these are immature hookworms of dogs and cats. *Gnathostoma* is also responsible for the creeping eruptions in man in certain parts of the world and it has also been reported by Maplestone (1929) from Jalpaiguri (Bengal) in India.

Reservoir Hosts

Many flukes which infect man are the common parasites of animals which are thus termed as "Reservoir hosts". Examples are found in *Clonorchis, Paragonimus* and *Fasciolopsis.* These are parasites of dogs, cats or

pigs, but may at times infect man. Cases of *Clonorchis* and *Fasciolopsis* have been reported from India, but *Paragonimus* infection is not known. Again *Schistosoma japonicum* has recently been reported by Bhalerao (1934) from pigs in India. All these occurrences help to keep the supply of infected snails from which infections can spread in all directions. It would thus appear that the control of human disease due to helminth parasites is not possible without control of disease in animals, and if we wish to control human disease we must simultaneously attempt to control disease in animals.

Unfortunately, there are great many difficulties for the adequate control of helminthic infections in animals. For instance, we find that the animals soil their food with their own fæces, they eat uncooked food and drink from ponds and streams which they contaminate themselves and thus there are limitations of sanitation for animals. All these lead to the abundance of parasites of the stock animals.

Besides, the modern means of transportation add further to the source of infections. The responsibilities of tourists in the transportation of disease are fully recognised. Similarly the transportation of stock would predict the transportation of their parasites.

The parasitism of the live-stock is, therefore, a real threat, and with it the eradication of human parasites is difficult. There is, thus, a necessity of work on co-operative basis between the medical and veterinary staff of a country. They must work together to bring about an adequate solution of parasitic infections of man and animals, as there must be simultaneous eradication of disease in all.

The general methods of prevention and control were summarised by Leiper thus:—

1. Medication by means of anthelmintics and therapeutic drugs.
2. Prevention of the entry of the infective stage by any of the following means:—
   (*a*) Avoid exposure to infective soil. Use of boots recommended.
   (*b*) Avoid open air bathing in places liable to contamination.
   (*c*) Avoid use of unfiltered water for domestic purposes.
   (*d*) Avoid use of uncooked foods.
   (*e*) Avoid overstocking.
3. Destruction of intermediaries by chemical and other means.
4. Destruction of reservoir hosts.
5. Proper disposal of manure.
6. Clean stables.

These methods individually or collectively would greatly reduce chances of infections. But perhaps, the best means to avoid the perpetuation of the parasite is to cut down its life-cycle. This needs co-operation of workers in various fields.—Medicine, Veterinary, Agriculture and Zoology. The necessity of co-operation between medical and veterinary investigators is emphasised on the fact of the common type of helminthic infections of man and animals and attention has been drawn (earlier in this article) to the difficulties of the control of helminthic infections of animals. It is true that the application of sanitary methods will eradicate diseases that are exclusively human, but this cannot apply to animal diseases. Co-operation of workers is essential to find a common solution. There are a large number of parasites whose life-histories have not been worked out and this needs the assistance of zoologists. A zoologist, on account of his training in comparative anatomy, is in a better position to understand and help in the study of the intricate problems connected with the life-histories. Leuckart suggested, from the study of the structure of the infective larvæ of *Cucullanus* and *Dracunculus*, the solution of the life-history of the latter. Recently, zoologists have shown by the study of "Cascado" in Dutch East Indies that the cause of this skin disease is not "mange mite" as was originally supposed, but the disease is due to the presence of a nematode worm of the genus *Stephanofilaria*. In this connection I would like to draw attention to the organisation of the Institute of Agricultural Parasitology in London, which is based on such co-operation. On the staff of this Institute under the direction of Professor R. T. Leiper, F.R.S., there are medical and veterinary graduates co-operating with those in agriculture and zoology, and we know that as a result of co-operation researches of far-reaching importance have been conducted at this Institute. This co-cpereation has been emphasised even by the Royal Commission on Agriculture in India, presided over by our ex-Viceroy, Lord Linlithgow.

The foregoing remarks have sufficiently stressed the economic importance of the subject. It is, therefore, suggested that this matter may be given due consideration both by the Government and the public with a view to give it a proper place in the post-war reconstruction of scientific research in India.

---

1. Bhalerao, G. D., "On the occurrence of *Schistosoma japonicum* in India," *Ind. Jour. Vet. Sci. Anim. Husb*, 1934. 2 Cameron, T. W. M., "The helminth Parasite of animals and human disease." *Proc. Roy. Soc. Med.* 1926. 3. —, "Parasitic diseases common to man and animals," *Brit. Med. Jour.*, 1934. 4. Khalil, M. "The relation between sanitation and Parasitic Infections in the Tropics." *Jour. Roy. Sani. Inst* 1926. 5. Mahadevan, V., "Hydatid Disease in South India." *Ind. Med. Gaz.*, 1933. 6. Maplestone, P. A., "A case of human infection with gnathostome in India., *Ibid.*, 1929. 7. —, "A new case of *Bertiella Studeri* in Human being." *Ibid.*, 1930. 8. —, "The frequency of Hydatid disease in India." *Ibid.*, 1933. 9. —, "The eggs of *Tænia Solium* and *Tænia Saginata*." *Ibid.*, 1937. 10. Maplestone, P.A., and Bhaduri, N. V., "*Tænia solium* and *Cysticercus cellulosæ* in India." *Ind. Jour. Med. Res.*, 1937. 11. Maplestone, P. A. and Riddle, J. S., "Infection with *Bertiella Studeri*." *Ind. Med. Gaz.*, 1936.

PALÆOBOTANY IN INDIA

THE latest issue (No. V, Sep. 1944) of *Palæobotany in India*—a Bulletin of current palæobotanical research in India—published from Lucknow under the editorship of Professor Birbal Sahni contains summaries of as many as 31 papers dealing with the recent work being done on fossil plants coming from various rock formations in India ranging in age from the Devonian to the Pleistocene, and constitutes an impressive record of the increasing volume and importance of palæobotanical work carried out in India during recent years under the inspiring guidance of Prof. Sahni. Among the more important studies recorded in the Bulletin, mention may be made of the papers by Prof. Sahni and his collaborators, H. S. Rao, S. R. N. Rao and V. B. Shukla, on the flora of the Deccan intertrappean series, further revealing the interest and importance of this flora both from the stratigraphical and palæobotanical points of view, the papers by A. R. Rao, B. P. Srivastava, K. M. Gupta and P. N. Ganju dealing with the flora from the Rajmahal Hills, and those of G. S. Puri on the fossil plants from the Karewas of Kashmir.

Of outstanding interest as a contribution to one of the most controversial problems of Indian geology and one which is bound to stimulate further discussion, is the paper by Professor Sahni on "The Age of the Punjab Salt in the Light of Recent Evidence" which was first delivered as the Presidential Address at Hyderabad at a joint meeting of the National Academy of Sciences and Indian Academy of Sciences in December 1943 and an abstract of which is published in the Bulletin under review. The full address has been more recently published in the *Proceedings of the National Academy of Sciences*. The evidence of the microfossils recovered from the beds of the Saline Series—"shreds of angiospermous and coniferous woods (some of them carbonised), isolated wood elements with simple or bordered pits, pollen grains of angiosperms, cuticles of grasses, fungal hyphæ and insect-remains including a new and extinct species of Diptera"—is, according to Prof. Sahni, entirely in support of the Tertiary age for the salt and altogether rules out the idea of the Cambrian age.

With the present number, *Palæobotany in India* which was so far being published in the *Journal of the Indian Botanical Society*, appears under the auspices of the National Academy of Sciences. Compared with the previous numbers, the Bulletin is now enlarged and its contents are more elaborate and comprehensive, and more profusely illustrated. Under the able guidance of Prof. Sahni, we have no doubt that this Bulletin will soon grow and develop into a regular first-rate journal of Indian Palæobotany.

REORGANISATION OF THE MYSORE GEOLOGICAL DEPARTMENT

THE Mysore Geological Department, originally organised in 1894, for conducting a geological and mineral survey of the State, was in later years obliged to curtail much of its activities on account of severe retrenchment to which the Department was subjected. Within the last ten or twelve years, however, the Department has started on an extensive programme of large-scale prospecting, mining, geophysical and soil surveys, including underground water resources. The limited staff at its disposal was found to be absolutely inadequate to cope with this continually growing volume of work, and realising the need for its urgent increase, the Government of Mysore have recently reorganised this Department sanctioning fully the proposals of the Director.

Under the scheme now sanctioned, the routine geological work in the State will be allocated among three Divisions to be newly constituted, each Division forming a unit comprising three administrative districts in Mysore. Each of these divisions will be in charge of a Division Geologist, who will be responsible for all routine geological work within his division, subject to the administrative control of the Director. He will be assisted by two Assistant Geologists. Assaying and other laboratory investigations of a purely scientific and fundamental character will be carried out under the immediate supervision of the Director.

The technical and administrative staff includes one Senior Geologist, three Geologists, six Assistant Geologists, one Geophysicist, one Assistant Geophysicist, one Inspector of Quarries and Museum Curator, two Chemists and one Assistant Chemist.

SIR LAWRENCE BRAGG ON SCIENTISTS AND THEIR PUPILS

"THE majority of scientists after the first decade of research careers continue to live their scientific lives for the most part through their students. Battening upon students, using their freshness for selfish ends, is of course one of the major scientific crimes, and unhappy is the laboratory which has such a head. But there is a better and more normal side to the picture: the purest pleasure in scientific work is to see the germ of an idea one has planted in a younger man's mind develop in a way and to an extent one could not have achieved or foreseen oneself, and to see him get recognition for his work."

(*Discovery*, 1944, 5, 102.)

LETTERS TO THE EDITOR

PRODUCTION OF THE *EIGAT-EFFECT* UNDER X-RAYS

PREVIOUS work[1,2,3,4,5,6] on this phenomenon showed that when chlorine and other gases subjected to an electric discharge, are irradiated in different parts of the visible spectrum, an instantaneous[6] and a reversible current *decrease* Δi, is produced, which increases by increasing the intensity and especially the frequency of light. With essentially the same experimental arrangement as before, the observation of this effect has now been extended to irradiation with X-rays.

A sealed glass ozonizer of the Siemens' type filled with pure chlorine at 26 cm. pressure was kept at a target distance of 2 ft. from a Coolidge tube. The discharge current i was determined with a Cambridge vacuo-junction connected to a reflection galvanometer. At 10·7 kilo-volts (r.m.s.) applied to the ozoniser and 50 cycles frequency, i in the dark was 62 in arbitrary units. This decreased almost immediately[6] to 51, that is, by about 17 per cent. on expossure to X-rays; interception with a lead screen caused the current to increase immediately[6] to its original value. Light from a 200-watt incandescent bulb instead of X-rays, produced a current decrease Δi of 25 per cent. Increase of intensity, as judged from the fluorescence of the test screen, obtained by a variation of the tube current in the range 1 to 4 milliamps did not produce an appreciable increase in Δi. That this may be ascribed, in part, to a saturation effect was suggested by the result that the light-effect Δi was about 25 per cent., when the chlorine tube was irradiated *simultaneously* by the incandescent bulb and X-rays.

It is found that a continuous 30 minute exposure of the chlorine tube to an intense beam of X-rays produced a permanent diminution in the magnitude of the light-effect. The corresponding influence of radiation from the incandescent bulb was much smaller despite 16-hour daily exposure for over fifteen days.[8]

The ionization potentials of all elementary gases are higher than 10 volts. It is to be anticipated therefore, that their photo-electric ionization would occur at wave-lengths shorter than 123·4 Mμ. A number of investigations have, however, detected photo-ionisation at sensibly longer wave-lengths than the above limit. This has been attributed to a 'cumulative effect'. It is that one of the photo-excited atoms and/or molecules ionises on collision with another excited particle or by capturing a second quantum. The occurrence under electric discharge of an appreciable number of particles in energy states higher than the normal, is well established by the spectroscopic and other evidence. From this it follows that *ceteris paribus*, an exposure of a gas to discharge, would favour its cumulative photo-ionisation. The occurrence of as much as a 17 per cent. decrease of the discharge current in chlorine consequent on irradiation with X-rays—a powerful means of ionisation—is remarkable. Such a diminution of the conductivity, as far as I am aware, has not been observed hitherto in the literature of the X-ray phenomena. It is obviously of vital significance to the elucidation of the general mechanism of *the light-effect*.[1,2,3,4,5,6]

Department of Chemistry,
Benares Hindu University, S. S. JOSHI.
October 21, 1944.

1. Joshi, *Curr. Sci.*, 1939, **8**. 48. 2. — *Pres. Address Chem. Sec. Indian. Sci. Cong.*, (1943). 3 —, *B.H.U. Journ.*, 1943, **8**, **99**. 4. —, *Nature*, 1944. **154**, **147**. 5. Joshi and Deo, *ibid.*, 1944, **153**, **434**. 6. For a possible time-lag, *cf.*, Joshi, *Curr. Sci.*, 1944, **13**, **253**. 7. Lenard and Ramsauer, *cf.* Hughes and DuBridge, "*Photo-Electric Phenomena*." 1st ed., *p.* 279, 283 (*Mc Graw-Hill Book, Co. Inc.*, 1932). 8. Deo (unpublished results).

THE ULTRA-VIOLET BANDS OF HgCl

EMISSION bands due to the HgCl molecule are known in two regions in the ultra-violet. While there is agreement about the analysis of one of the systems (*i.e.*, lying between λ 2650 and λ 2400) the assignment and analysis of the other (*i.e.*, lying between 2900 and 2700) do not appear to have been definite. Cornell[1] formed these into sequences of what he termed as Q heads and interpreted the accompanying weaker bands to be P branches. Wieland[2] doubts Cornell's classification and attributes the weak P heads and the stronger Q heads to the isotopic molecules $HgCl^{37}$ and $HgCl^{35}$. Sastry[3] extended Cornell's Q sequences of heads, designated them as Q_1 heads and arranged the additional bands that he measured into Q_2 sequences.

In a recent paper on the bands of HgF and other related molecules, Howell[4] has suggested the possible existence of a second system of HgCl bands in the region λ 2900 to λ 2700. In the light of his observations, a reinvestigation of the HgCl bands between λλ 2900 and 2700, has been made by the authors to examine (1) if Wieland's interpretation of the isotopic origin of the P heads can be correct and (2) if the second system suggested by Howell can be definitely established.

Estimates of the intensities have been made of the P and Q heads, particularly of the (0,0) and (1,0) sequences. The P head intensity is found to fall off much more rapidly than the corresponding Q head intensities, which is inconsistent with Wieland's interpretation.

Eight diffuse bands, with unresolved structure, in this region (which were mentioned by Cornell and only partially recorded by Sastry) have been measured. As suggested by Howell, these could be arranged into a second system with the (0,0) band at λ 2790·29 and (0,1) at λ 2811·38. This system can be regarded as the second component of the $^2\pi - ^2\Sigma$ system of HgCl, the first being the one further to the violet between 2650 and 2400. The doublet interval between these components is approximately equal to ·3889 cms.$^{-1}$ entirely in keeping with the value 3934 found for HgF bands by Howell. Full details will be published elsewhere.

Andhra University,
Guntur, K. R. RAO.
October 24, 1944. G. V. S. RAMACHANDRA RAO.

1. Cornell, *Phy. Rev.*, 1938, **54**, 341. 2. Wieland, *Helv. Phy. Acta.* **1929**, **2**, **46**, and **1941**, **14**, 420. 3. Sastry, *Proc. Nat. Inst. Sci. Ind.*, **1941**, **7**, 351. 4. Howell, *Proc. Roy. Soc.*, (Lond.), **1943**, **A.182**, 95.

TOURMALINE SCHISTS FROM HOLENARSIPUR, HASSAN DISTRICT, MYSORE STATE

DURING a recent visit to the schistose rocks occurring to the east and north-east of Yenneholeranganbetta near Holenarsipur, specimens of what looked like a black mineral were collected. They occur in great profusion all along the western flanks of the line of hills commencing from south-west of Tattekere and ending in △ 3061 due east of Yenneholeranganbetta (△3161). *In situ* occurrences were not noticed.

The specimens were found in lumps of different sizes varying in diameter from ½″ to 2½″. They have a dull black colour, and on a casual examination in the field may be mistaken for an amphibole. The lumps are often smooth but sometimes exhibit a crude columnar habit, and freshly broken surfaces reveal a very fine fibrous structure. Irregular transverse and longitudinal cracks traverse the specimens. The specific gravity was found to be 3·12.

Under the microscope, they were seen to be composed entirely of a very compact aggregate of minute tourmaline crystals forming a felted mass. As will be seen from Fig. 1, there is a definite schistosity produced by most of the crystals lying in parallel orientation, only a few crystals not conforming to the prevailing direction.

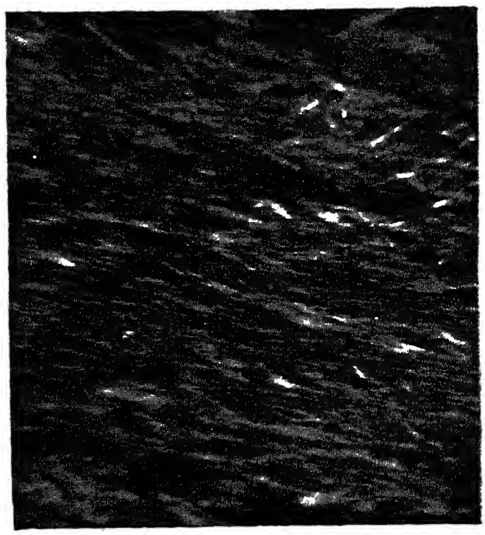


FIG. 1

Photomicrograph of Tourmaline schist. Polarised light. ×50. The little prisms of tourmaline generally have a common orientation.

The following are the optical characters of the mineral. Absorption O > E. Optically negative. Birefringence, $\omega - \epsilon = \cdot 032$. Indices of refraction, $\epsilon = 1\cdot 630$, $\omega = 1\cdot 662$. Pleochroic scheme, X = colourless, Z = dirty green.

The specific gravity, refringence, and birefringence of the mineral indicate that it may be an intermediate member either of the dravite—schorlite or schorlite—elbaite series of tourmalines. Spectrographic examination of the arc spectrum of the mineral powder was kindly made for me by Dr. B. V. Raghavendra Rao of the Physics Department, Central College. This revealed the presence of the most persistent and easily reversible line of lithium at λ 6707·86 Å. The presence of lithium indicates that the tourmaline belongs to the schorlite-elbaite series; the specific gravity and optical characters conform to an isomorphous mixture

of schorlite and elbaite in the proportion of 3:2 approximately.

The origin of these tourmaline schists is ascribable to the influence of the neighbouring Gunjur Betta granites. Small crystals of tourmaline of similar optical properties are found in the rocks of this area, but schists composed predominantly or entirely of tourmaline have not so far been recorded.

Department of Geology,
University of Mysore, C. S. PICHAMUTHU.
Central College, Bangalore.
November 3, 1944.

GROWTH-PROMOTING FACTORS FROM GROUNDNUT OIL

IN a previous communication[1] we have shown that the growth-promoting factors associated with groundnut oil can be effectively removed by chromatographing the oil through columns of alumina (Brockmann, Merck). Diets prepared with oils thus purified, could not support the growth of the rice moth larvæ (*Corcyra cephalonica* Staint). It was of interest to determine if the adsorbed columns could be washed with suitable solvents to yield the growth-promoting factors in an active condition.

The columns were washed once with a small quantity of petroleum ether (40°-60°) to remove the excess of groundnut oil and then treated with a 1:1 perol-ether-methyl-alcohol mixture. The solvent mixture was removed from the eluate by evaporation *in vacuo* and the residue taken up with peroxide-free ether and used for the preparation of the diets, the chloroform extracted jowar was employed as the basal medium. 4·28 per cent. of the eluate was added to the diet. This proportion corresponds to the percentage of chloroform soluble extract of the jowar employed in our studies.

Batches of 10 days old larvæ previously fed on whole jowar for the period, were first maintained for a term of six days on chloroform extracted jowar. They were then transferred to the experimental diets and weighed at intervals. The results are given in Table I.

Average weight of 10 larvæ in mgms. after

Diet	Days					Remarks
	0	14	23	28	35	
I	9·8	19·6	32·5	51·5	40·6	None pupated
II	9·6	58·8	142·1	164·5	172·8	30% pupated

Diet I.—Chloroform extracted jowar + chromatographed groundnut oil (4 28 per cent.).
Diet II.—Chloroform extracted jowar + eluate from the chromatogram (4·28 per cent.).

It will be seen from the table that the growth-promoting factors can be eluated from the chromatographed columns of alumina.

A portion of the eluate was saponified with alcoholic potash and the unsaponifiable fraction extracted with peroxide-free ether, A diet containing the chromatographed groundnut oil (4·28 per cent.) was supplemented with 0·26 per cent. of the unsaponifiable matter. Adopting the same technique, feeding experiments were carried out with the larvæ of the rice moth. Results are given in Table II.

Average weight of 10larvœ in mgms. after

Diet	Days				Remarks
	0	14	21	28	
I	25·3	71·5	176·2	Pupation 33 per cent.	
II	24·0	118·5	204·1	55 ,,	

Diet I.—Chloroform extracted jowar + 0·26% unsaponifiable matter + 4·28% of thrice chromatographed groundnut oil.
Diet II.—Chloroform extracted jowar + 4·28% eluate.

The results establish that the growth-promoting factor of the groundnut oil is intimately associated with the unsaponifiable portion of the eulate. The data presented in the tables suggest the existence of a "pupation" factor which is also associated with the unsaponifiable portion of the oil.

Section of Fermentation Technology,
Indian Institute of Science,
Bangalore, (MISS) VIOLET DE SOUZA.
November 6, 1944. M. SREENIVASAYA.

1. *Curr. Sci.*, 1942, **11**, 462.

THE INFLUENCE OF FEED UPON THE COMPOSITION OF TERMITE SOILS

THE harmful role of the termites is widely known in the tropics. At the same time it is now pretty well known that they contribute to a certain extent to the general fertility of a soil and termite soils have been found to be quite rich in plant food nutrients. Compact cellulosic material which can be decomposed only with difficulty, are literally converted into fine soil by their action in a short time.

Termite soils, however, vary greatly in their composition in relation to the neighbouring normal soil. Soils from an active termite heap at Nigeria[1] have been found to be extraordinarily rich. Those examined previously by Engle,[2] though richer in plant foods than an adjacent soil had much less quantity of plant nutrients than the Nigerian heaps. Though environmental conditions must be having much to do with the activity of the termites it was suspected that among the factors, which influenced the changes in the composition of the soil brought in by them the nature of the material they feed upon is expected to be one. With this object in view the analysis of the soil brought in by the termites feeding on different materials like paper, wood, etc., was undertaken.

The movements of termites on a wooden window could be interrupted by breaking down the soil already on the wood and placing bits

of wood, paper and dried cowdung on an artificial platform. The material was completely eaten up by the termites every night. The soil on the platform was broken up, collected and fresh material put on it. This way, the soil brought in by the termites on each kind of material was collected till the amount was sufficient for detailed analysis. On analysis, the following results were obtained.

Constituents	Adjacent soil	Soil brought by the termites feeding on		
		Paper	Wood	Dried cowdung
pH	7·5	8·6	8·4	8·1
Sands	76·91	70·36	67·58	69·38
Silt	12·76	13·14	15·04	14·20
Clay	10·33	16·50	17·38	16·42
Carbon	·126	·450	·220	·562
Nitrogen	·012	·030	·034	·082
CaO	·31	·49	·74	·69
P_2O_5	·03	·08	·07	·09
K_2O	·57	·93	·77	1·00

This showed that there was difference between the composition of termite soils growing on different feeds. The soil on cowdung was particularly rich in general plant food nutrients.

My thanks are due to Dr. S. V. Desai for encouragement and many valuable suggestions.

Imperial Agricultural Research Institute, New Delhi, ABHISWAR SEN.
October 27, 1944.

1. Nigeran Forrester, 1, 8 from *Nature*, 1940, **148**, 3750. 2. Engle. H., *Manual of Agricultural Chemistry*, 1912, p. 50.

A FAST REACTION WITH SODIUM HYPOCHLORITE AND AMMONIUM HYDROXIDE

THE reaction between sodium hypochlorite and ammonium hydroxide is well known, being usually represented by the equation,

$$3\ NaOCl + 2\ NH_4OH = 3\ NaCl + 5\ H_2O + N_2.$$

According to this equation, a reaction, in which the molar ratio of NaOCl and NH_4OH was 1·5 at the start, should go to completion. We, however, found that such a reaction did not go to completion. When the ratio was increased slightly, the reaction apparently continued even after all the NH_4OH was exhausted, according to the equation. This was seen from the fact that when the reaction stopped, the observed decomposition of NaOCl was always more than that calculated from the equation. The reactions were also abnormally fast. When the molar ratio of reactants was 1 or 0·5, the time for half-reaction varied from 100 to 400 minutes depending upon the concentration. With the previous reactions, however, a major part was over in the first few minutes as the following table will show.

No.	NaOCl	NH_4OH	Ratio	Time for half-reaction
1	0·0225M	0·015M	1·5	14 min.
2	0·0375M	0·025M	1·5	8 min.
3	0·06 M	0·04 M	1·5	4 min.
4	0·15 M	0·1 M	1·5	1 min.
5	0·2 M	0·125M	1·6	about 1 min.
6	0·3 M	0·125M	2·4	about 1 min.
7	0·4 M	0·125M	3·2	about 1 min.

The reaction solution frequently became acid in the end and developed a strong smell of some nitrogen halide. Further work to elucidate the mechanism of this reaction is in progress.

Department of Chemistry, Ramnarain Ruia College, Bombay 19. S. P. MORE. V. K. BHAGWAT. B. V. MOHILE.
October 21, 1944.

EFFECT OF CERTAIN VAT DYES ON THE STABILITY OF SODIUM HYPOCHLORITE SOLUTIONS

THE vat dyestuffs as a class are characterised by their general all-round fastness properties. But, there are a few exceptions to this generalisation. For example, Indanthrene Green B. Indanthrene Blue R and a few of the substituted Indigoid vat dyes possess poor fastness to the action of hypochlorite solutions.

During the course of an investigation on the oxidation of vat-dyed cotton cellulose by hypochlorite solutions, the following interesting observation has been made.

Cotton dyed with Ciba Blue 2B was kept in contact with suitably buffered sodium hypochlorite solutions containing approximately 2·5 gm. of available chlorine per litre, the material liquor ratio being 1:50. After keeping it in contact with this solution for ten minutes, the dying was removed. It appeared to have faded considerably due to oxidation of the dyestuff. The hypochlorite solution was examined for loss in strength. Blank was kept side by side to determine the self-decomposition. It was interesting to observe that the rate at which the blank solution decomposed was very much lower than the rate at which the solution used for the oxidation of the dyeing decomposed. For example, during the first twenty minutes after the dying was removed, the hypochlorite solution buffered at pH 7 lost in strength equivalent to 4 per cent. of the total oxygen available per litre. On the other hand during the same period, the blank showed a loss of 1 per cent. This rapid rate of decomposition of the former solution was continued for about two hours and after this period, the rates of decomposition of the two solutions were nearly the same. This behaviour has been shown to exist with hypochlorite solutions having both alkaline and acidic pH values. The increased rate of decomposition in presence of the dye is found to depend on the pH of the solution, and also on the amount of dyestuff present on the fibre. It appears

that the products of oxidation of Ciba Blue 2B enter the hypochlorite solution and catalyse it even after the dyed cotton has been removed from the solution. Experiments are in progress to investigate this interesting observation.

Dept. of Chemical Technology,
University of Bombay,
Bombay,
September 29, 1944.

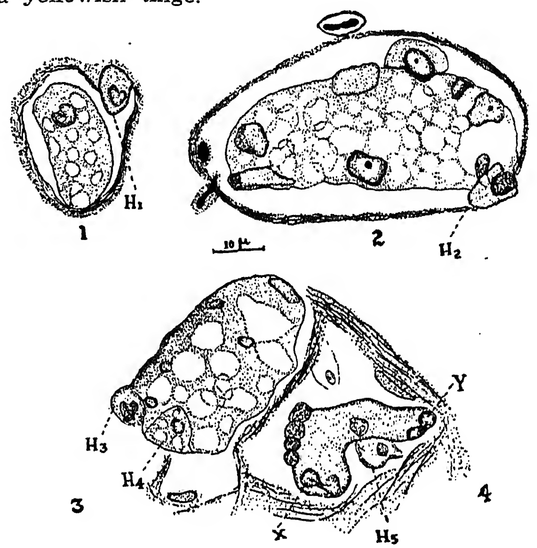
K. S. BHUJANG.
S. H. MHATRE.
G. M. NABAR.

FORMATION OF MULTINUCLEAR CELLS IN LEPROUS LESIONS

ARE Langhan's giant cells described in tuberculoid leprosy comparable to multinucleated vacuolate giant cells seen in lepromata? Is the marginal arrangement of nuclei a necessary criterion for comparison? Are we seeing entirely specific types? The recent publication by Cowdry[1] of photomicrographs showing giant cells in rat leprosy attracted me to this problem. Are these giant cells the product of mere multiplication of nuclei or are they formed by fusion of discrete cells? Some interesting results obtained in this direction are described below.

The material studied was a skin clipping obtained through the kindness of Dr. Shama Rao, Leprosy Officer to the Government of Hyderabad. This is a small nodule showing in smears bacilli with "seed row" arrangement of granules (see Subramaniam[2]). The material was fixed in Regaud's fluid and attempts to stain the bacilli with Ziehl-Neelsen technique resulted in a thorough failure. Various modifications of the technique were employed but the pictures obtained of the bacilli lacked clarity and were, therefore, rejected. The sections were then bleached with potassium permanganate and oxalic acid and stained in iron hæmatoxylin.

The vacuolate lepra cells do occur only in the deeper layers of the dermis. In the series of sections examined by me they were never observed in the papillary layer. Other skin clippings from the same patient were fixed in various fluids and of all the fixatives only formalin gives clear pictures of the bacilli. In Zenker the bacilli take the stain but they lack clarity. The curious fact observed was that while masses of bacilli could be observed in the papillary layer in formol material, often touching the lowermost layer of the epidermis, no Virchow cells could be discovered in that layer. All gradations of vacuolation leading to the typical foamy Virchow lepra cells have been observed in the series of sections. These cells occur in spaces in the connective tissue network and always have a clear area surrounding them. In Fig. 1 is shown a lepra cell with vacuolation, but with only one nucleus. Near it and lying in the clear area surrounding it is a histiocyte (H_1). Fig. 2 is that of a giant cell showing marginal arrangement of nuclei. Such an arrangement, therefore, is not characteristic of giant cells in tuberculoid leprosy alone. Photomicrographs 9 and 10 of Cowdry[1] show a similar arrangement of nuclei in lesions of the rat. In this slide which was not counterstained, the nuclei alone are stained and the cytoplasm is yellow. The nuclei are irregular in shape and in a few what look like nucleoli occur. At H_2 could be seen a histiocyte lying in close contact with the giant cell. The cytoplasmic outline of the histiocyte could just be made out and in its non-vacuolate cytoplasm could be observed a few refractile granules having a yellowish tinge.



In Figs. 3 and 4 are illustrated a giant cell with vacuolation and another without any foamy appearance lying side by side. At H_3 is a histiocyte with distinct outlines lying in close contact with the giant cell. It has a cordate nucleus and its cytoplasm is light pink being stained by eosin. At H_4 is another which gives one the impression that it is just fusing with the giant cell. Its cytoplasm is vacuolated, but its outline is very clear.

Separated from the above cell by only a clear space is a non-vacuolate giant cell (Fig. 4) whose disposition and irregular outline reminds one of text-figures of connective tissue unicellular histiocytes. Most of the nuclei are at the margin and those at X and Y are suggestive of amitotic division. At H_5 is another cell which only careful examination reveals as distinct from the giant cell. Its cytoplasm and nucleus exactly simulate the staining reactions of the giant cell.

Mitsuda[3] from his study of the lepra cells in various organs suggests "that in the majority of cases, the lipoid substance is produced in the cell as opposed to its origin from bacilli that have entered there". Cowdry[1] describes "rosette" formation in rat leprosy but unlike in the human globi, he states, that there is no "schleim" associated with these "rosettes". We have in the literature a variety of grades. (1) Giant cells with bacilli and lipoid as seen in lepromata. (2) Giant cells without schleim but with bacilli as in rat leprosy. (3) Vacuolated cells with lipoid but with no bacilli as observed by Mitsuda in the mesenteric lymph glands of man and (4) Giant cells with no bacilli or lipoid as seen in major leprides.

This leads one to the question whether

these varying types may after all not be the different expressions of one and the same type of cell? In the connective tissue of the skin one finds a variety of cells. All these various forms have been considered by many cytologists as transitional forms between the small lymphocytoid and monocytoid cells to the histiocytes on the one hand and between histiocytes and fibroblasts on the other.

In infection and inflammation it is the histiocytes that are mobilized as active phagocytes. These active elements are capable of not only storing colloidal acid and basic dyes but also droplets of fat and lipoid. Accumulation of lipoid, therefore, in lepra cells appears to be not a new phenomenon at all. When mobilized the histiocytes assume a variety of shapes. Giant cells have been frequently noticed in the peritoneal exudates of rabbits injected with repeated doses of lithium carmine. Maximow[4,5] recorded that in tissue cultures these polyblasts may fuse to form giant cells.

Observations presented by me show that giant vacuolate cells are formed more commonly by addition of active cells with no sign of vacuolation to cells which have already assumed a foamy appearance. Such a phenomenon leads one to the conclusion that there is an attempt on the part of the active macrophages to reinforce those which are being immobilized by the bacilli engulfed by them. The formation of giant cells which show no vacuolation and occurrence in such cells of amitotic division indicate that fusion may not be the only method of origin of such cells.

The reaction of the organism shown in tuberculoid leprosy differs widely from that of the lepromatous variety. It is perhaps in consonance with this difference that we find a difference in the formation and nature of the giant cells. Is it not possible then, that these variations observed in structure and mode of formation of giant cells in various types of leprosy are after all the different expressions of one and the same type of cell to different conditions encountered?

Hyderabad (Dn.), M. K. SUBRAMANIAM.
September 26, 1944.

1. Cowdry, E. V., *Puerto Rico J. Publ. Health and Trop. Med.* Sept. 1938, **1.** 2. Subramaniam, M. K., *Curr. Sci.*, 1944, **13,** 261. 3. Mitsuda. K., *Internat. J. Leprosy*, 1936, **4,** 4, 409. 4. Maximow, A., *Arch f. mikr. Anat.* 1922, **96,** 494. 5. —, *Ibid.*, 1922, **97,** 283.

* I am very thankful to the Vice-Chancellor of the Osmania University for permisslon to work in Dr. Mahdihassan's laboratory and as Cytologist to Messrs. Biochemical and Synthetic Products Ltd., for their encouragement.

ON THE DIFFERENTIATION OF DEAD FROM LIVING MYCOBACTERIUM LEPRÆ

ON the availability of a technique to differentiate the dead from living bacilli in a lesion depends the scientific evaluation of the therapeutic value of even Hydnocarpus preparations. Hansen discovered the bacillus in 1874 but even in 1939 we find Cowdry[1] stating: "What proportion, if any, of the bacilli in a given lesion are dead is at present purely a matter of speculation." The new technique devised by one of us (Subramaniam[2]) suggested a possible mode of attack of this problem. Serial sections of formol fixed skin clippings from an advancing lepromatous case when stained with Ziehl-Neelsen showed innumerable bacilli. These identical slides when destained with potassium permanganate and oxalic acid and stained with Heidenhain's hæmatoxylin presented a curious picture. The bacilli were red, blue or of mixed hues. The proportions of these variously stained bacilli differed from slide to slide but what was more important the number of bacilli seen in the sections was far less. What is the cause for the disappearance of a considerable number of bacilli seen in the same section after the preliminary Ziehl-Neelsen staining? The question was whether the bacilli which disappear get washed off during the potassium permanganate and oxalic acid treatment or whether they are the dead ones which cannot be stained with iron hæmatoxylin after the above treatment.

Since dead bacilli have been known to persist in tissues for over an year (Lowe[3]) any smear or section ought to contain living and dead bacilli. Attention was, therefore, directed to the application of the technique to smears. The usual method of fixation of smears is by heat. In slides fixed in the above manner one can possibly expect only *dead* and *killed* bacilli. For, even those bacilli which were alive at the time of smearing are killed by heat. If, on the other hand, a wet smear is fixed in 25 per cent. formalin for 30 minutes one ought to expect *dead* and *fixed or preserved* bacilli. The behaviour of the bacilli in the differently treated smears were different.

When formol and heat fixed smears are stained in carbol-fuchsin overnight, differentiated in 1 per cent. hydrochloric acid alcohol and counterstained with Loffler's methylene blue, then in each field could be seen hundred or more bacilli. If instead of methylene blue the slides are treated for two hours with Heidenhain's iron alum, an hour with hæmatoxylin and differentiated in the usual way, then also the same picture is seen. The bacilli appear red on a yellow background and the nuclei appear light or dark blue. Treatment of smears for even 24 hours with 1 per cent. acid alcohol does not destain any of the bacilli. But when the differently fixed smears are destained in stages with 0·25 per cent. potassium permanganate and 5 pere cent. oxalic acid there is a distinct difference. The bacilli in the heat fixed smears resist decolourization. While repetition of permanganate and oxalic acid treatment would destain most of the bacilli in formol fixed smears in about an hour, heat fixed bacilli require often two hours of alternating treatment with the above reagents. If especially the smear is very thin as if made with a bacterial emulsion, then a considerably longer time was found necessary. The destaining should be carried out very carefully and in stages, as otherwise the bacilli get loosened from the smear. In such cases the clear spaces originally occupied by the bacilli could be definitely distinguished in finished preparations. Our procedure was to keep the slides

in 0·25 per cent. potassium permanganate till the smear goes brown, and after washing it, to transfer it to 5 per cent. oxalic acid. The slide is then examined under the high power and if the bacilli are still red the process is repeated till no red bacilli could be made out. Many workers have commented on the remarkable acid-resistant nature of *M. lepræ* in smears as compared with that in sections (Lowe[3]). This becomes perfectly intelligible from the foregoing observations. Dead and killed bacilli are highly acid-fast while living bacilli fixed in formol are less so.

When heat and formalin fixed Ziehl-Neelsen stained smears destained in the above manner are stained with Heidenhain's hæmatoxylin two different pictures are obtained. The alterations in time of treatment with the mordant and stain make, if at all, very little difference. Our usual procedure was to keep the slides overnight in 4 per cent. iron alum, wash in running water for 10 minutes and keep it in the stain for two or three hours. Even if the above timings are reversed we found very little difference. Destaining correctly is an exacting procedure and unless great care is exercised the result will be a thorough failure. But when carefully done, the formalin fixed smears would show bacilli stained red, blue or of mixed hues. In heat fixed smears, a few red ones alone could be made out. The blue ones are conspicuous by their absence. Not only that. The blue bacilli in formalin fixed smears form only a varying percentage of those seen originally in the same smear after the preliminary Ziehl-Neelsen staining. In smears they constitute 10 and 15 per cent. and in sections of two lepromatous cases 4 and 40 per cent. respectively.

It appears from the above observations that the bacilli coloured blue or of a mixed hue alone are living while the red ones seen along with the above are dead. We have preparations showing blue bacilli alone in sections. Cowdry's[1] observations that individual globi differ in their acid-fastness, becomes intelligible in the light of the above results.

These blue staining bacilli could be demonstrated in both smears and sections fixed in formol, by staining ordinarily with Heidenhain's hæmatoxylin. On comparison with routine Ziehl-Neelsen stained smears and sections, the debris of the others tinted light blue could just be made out. When heat fixed smears are stained with Heidenhain's hæmatoxylin a few bacilli with indistinct outlines could be located. Since they roughly correspond in number with the blue bacilli seen in formol smears stained according to the new technique, it appears as if there is even a possibility of distinguishing between dead and killed bacilli.

Smear
Formol Fixation.
Ziehl-Neelsen.
↓
ALL BACILLI RED.
↓
Potassium permanganate and oxalic acid and Heidenhain's Hæmatoxylin.
↙ ↘
Unstained.—Dead. Blue.—Living.

Our results suggest that in the hands of experienced workers the above technique offers a method to differentiate between dead and living bacilli. We believe, the technique offers the leprologist a method to judge the progress of the disease and the scientist a method to evaluate the therapeutic value of the various drugs administered.

M. K. SUBRAMANIAM.
A. SHAMA RAO.
Department of Biochemistry,
Osmania Medical College,
Hyderabad (Dn.),
October 10, 1944.

1. Cowdry, E. V., *Puerto Rico J. Publ. Health and Trop. Med.*. Dec. 1939, pp 95–117. 2. Subramaniam, M. K., "Variations in the Acid-fastness of Mycobacterium Lepræ" (In press). 3. Lowe, J., *Internat. J Leprosy* 5, 1937 463–87.

* One of us (M. K. S.) would like to thank the Vice-Chancellor of the Osmania University for permission to work in Dr. S. Mahdihassan's Laboratory and as Cytologist to Messrs. The Biochemical and Synthetic Products Ltd. for their encouragement.

'SMALL-LEAF' DISEASE OF COTTON

'SMALL-LEAF', also known by the name of stenosis or smalling,[1] is a malformation of cotton plants commonly found in the Provinces of Bombay, Madras and the Punjab. In western India the herbaceum types are the worst affected, and a perennial cotton by the name of Rozi, *Gossypium arboreum* var. *typicum f. indica*, which is commonly cultivated in Kaira district in Bombay Province, appears to be particularly susceptible, especially in the first and second ratoons. In Madras Province, Mungari cotton, a mixture of *G. arboreum* and *G. herbaceum*, shows a high degree of susceptibility to the disease, which in the Punjab is mostly confined to the American types. The disease has never been reported among the Egyptian varieties.

'Small-leaf' is characterised by an extreme stunting of the aerial organs of the host (Fig. 1). Diseased leaves are variously lobed and malformed, and are of different shapes and sizes. In most cases mottling of the leaves and epicalyx is observed, but the latter is not deformed. Foliar growths or enations are produced on the veins on the under-surface of diseased leaves of American cottons. Sterility is a common feature of infected plants and is always associated with Rozi cotton, in which flowers on diseased plants remain very small and bolls are never formed.

As previously reported by Kottur and Patel,[2] 'small-leaf' affects the root development of affected plants, since the tap root in totally malformed plants seems to end abruptly giving rise to a number of secondary roots. In partially affected plants the root system is weaker and less extensive than in healthy plants. When the affection only results in the production of a malformed bunch of leaves at the base, the roots are irregularly branched and distorted. Diseased plants can be easily pulled out of the ground, with the tap root intact.

The disease has been studied by some investigators in India,[3,4] and attempts to transmit it by sap, by grafting and by insects have been

unsuccessful. It has been considered by some workers,[5,6] to be caused by virus, but others[7] have doubted its virus origin.

FIG. 1. (*a*) Healthy Rozi plant. (*b*) Rozi plant affected by 'small leaf' disease.

The present experiments on transmission of 'small-leaf' disease by grafting were done at Anand in North Gujerat and at Poona, under controlled conditions. The top of a healthy plant was cut off and the stem cut down the middle for about an inch. The stem of a diseased plant was cut to a wedge-shape and the wedge inserted into the cut stock. The junction was tied lightly but firmly with raffia tape covered subsequently with a mixture of paraffin and bees-wax in equal proportions. A few bud grafts were also tried.

FIG. 2. A grafted cotton plant showing diseased shoots arising from the stock. (*a*) Points at which diseased scion was grafted.

Fig. 2 shows a grafted plant of Rozi cotton, in which the new growths arising from axillary buds on the healthy stock exhibited typical symptoms of 'small-leaf' disease, indicating that the virus had travelled down to the stock from the diseased scion. When the graft was unsuccessful, the scion withered away and the new growth on the stock was healthy. But in some cases the virus passed down to the stock before the death of the scion as the new growths arising from axillary buds were diseased. Besides Rozi, the disease has now been successfully transmitted by grafting in American, Jarilla, Gaorani and Mungari cottons.

The above evidence clearly shows that 'small-leaf' disease is caused by virus and that it can be transmitted by grafting. The virus is not sap-transmissible nor does it seem to be transmitted by the seed. Experiments on insect transmission of the virus are in progress.

This work is being carried out under a scheme financed by the Indian Central Cotton Committee.

College of Agriculture, Poona,
September 23, 1944.

B. N. UPPAL.
S. P. CAPOOR.
S. P. RAYCHAUDHURI.

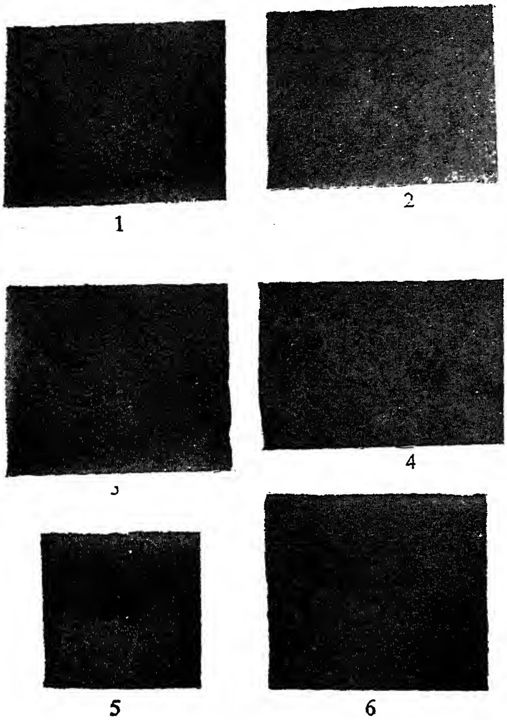
1. Cook, O. F., *Jour. Agric. Res.*, 1924, **28**, 803. 2. Kottur, G. L. and Patel, M. L., *Agric. Jour. India*, 1920, **15**, 640. 3. Afzal, M., *et al*, *Ind. Jour. Agric. Sci.*, 1935, **5**, 624. 4. Gokhale, V. P., *Ibid.*, 1936, **6**, 475. 5. Afzal, M., *Ibid.*, 1933, **3**, 933. 6. Uppal, B. N., *Ann. Rept. Dept. Agric., Bombay Province*, 1933–34, **176**. 7. Likhite, V. N., *Proc. Assoc. Econ. Biol., Coimbatore*, 1936, **3**, 15.

PRELIMINARY NOTE ON A NEW SPECIES OF *EREMASCUS*

DURING January 1941 a species of *Eremascus* was isolated from a betel-vine garden at Ramtek which behaved differently from any of the species so far described. Pure culture of the fungus was obtained and it gives a luxurient aerial cottony growth on rice-meal or glucose agar. The aerial hyphæ are sub-hyaline, highly granular, generally straight, more or less uniformly thick, sparsely branched, distantly septate and measure $1\cdot52\,\mu$ to $9\cdot54\,\mu$ in width (average $4\cdot32\,\mu$). The submersed hyphæ, measuring $1\cdot27\,\mu$ to $6\cdot36\,\mu$ in width (average $2\cdot92\,\mu$) are also sub-hyaline but less granular, more often tortuous than straight, irregularly thick, frequently branched and closely septate. As the culture grows older the aerial and submersed hyphæ both turn faintly pale-yellow.

Sexual reproduction is predominantly marked in this fungus. Two copulation branches arise from the sides or the ends of a hypha and coil spirally round one another (Fig. 1) and after one to several windings they meet at their tips and fuse (Fig. 2). The fused portion gradually gets abjointed from the copulation branches and eventually swells up to an eight-spored ascus (Fig. 3). In some cases it was observed that a few of the spores in an ascus degenerate. The asci, measuring $19\cdot71\,\mu$ to $28\cdot30\,\mu$ (average $19\cdot97\,\mu$) $\times$ $22\cdot26\mu$ to $37\cdot84\,\mu$ (average $31\cdot29\mu$) are thin-walled, hyaline, usually ovate, frequently pear-shaped and occasionally spheroidal in shape (Fig. 4). Asci are also produced parthenogenetically from fertile hyphæ

but they are smaller in size and contain less than eight spores. Ascospores are one-celled, globose, distinctly brown, typically spiny surfaced and measure $9 \cdot 98\,\mu$ to $11 \cdot 82\,\mu$ in diameter (average $10 \cdot 28\,\mu$) (Fig. 5).



Eremascus terrestris n. sp.
FIGS. 1–4. Development of copulation branches and ascus. × 900.
FIG. 5. Ascospres. FIG. 6. Conidiospores.

The fungus also occasionally produces round, smooth and hyaline conidiospores measuring $8 \cdot 20\,\mu$ to $12 \cdot 72\,\mu$ in diameter (average $10 \cdot 0\,\mu$) (Fig. 6).

So far only two species of *Eremascus*, *E. albus* Eidam and *E. fertilis* Stoppel, are reported. Though the present fungus very much resembles *Eremascus albus* Eidam in its sexual reproduction yet its habitat, cultural characters and size and shape of the spores justify it to be classed as a new species and is, therefore, named as *Eremascus terrestris* Asthana and Mahmud (n. sp.).

Agricultural Research Institute, Nagpur,
December 23, 1943.

R. P. ASTHANA.
K. A. MAHMUD.

A NEW SPECIES OF *ISOETES* FROM BANGALORE, MYSORE STATE

So far only two species of *Isoetes* have been recorded from India. *I. coramandalina* L., a common and widespread large species (McCann, 1934, Bharadwaja, 1935) and *I. sahyadrii* Mahabale, a small species found on the hill-tops of Mysore State and at Panchagani in Bombay Presidency (Mahabale, 1938). The other larger forms like *I. brachyglossa* Braun, described in 1862 from the Nilgiris, are now considered as a mere form of *I. coromandalina* by Dr. H. Reimers of Berlin.

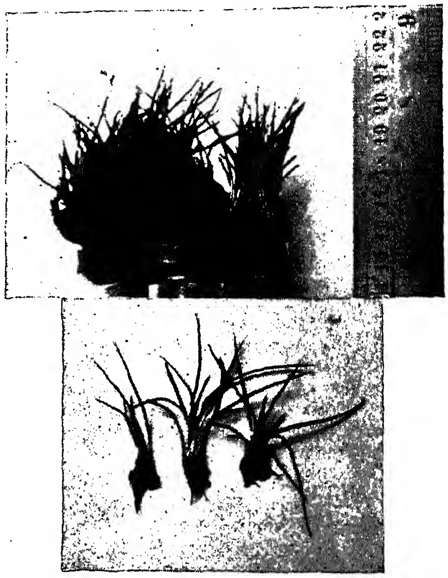


FIG. 1. A clump of soil with number of *Isoetes Sampathkumarani* sp. nov. Rao growing together.

FIG. 2. Three plants isolated to show their size and shape.

The author collected a species of *Isoetes* in Bangalore during August 1944 which, from a close morphological study, appears to be different from the two species recorded from India as well as most of the species recorded by Glück, Baker, Sadebeck, Eaton and Pfeiffer. The species under investigation though approaching in some of its characters very near *I. melanospora* Englm. and *I. lithophila* sp. nov. Pfeiffer of Pfeiffer and *I. melanospora* Engelm of Baker, both the species from The United States of America; yet it differs from *I. melanospora* in the size and shape of the leaf and sporangium, partly covered velum and the colour of the megaspores both when wet and dry and from *I. lithophila* in the size of the plant, absence of peripheral strands, size and shape of the sporangia, partly covered velum and the colour of the megaspores both when wet and dry. These important features in conjunction with its distribution in an isolated area have justified the erection of a new species.

CHARACTERS OF THE TYPE

Corn deeply two-lobed, leaves 3-16, spirally arranged, $1 \cdot 5$ to 9 cm. long in immersed forms and slightly longer in submerged ones, slender, with a membranous margin at the base and gradully tapering at the apex, spreading, subtetragonous in cross-section, stomata few near the leaf tip, $100\,\mu$ long and $50\,\mu$ broad. peripheral strands none, acicular crystals present, ligule triangular, longer than broad, measuring $1000\,\mu$–$1250\,\mu$ long and $500\,\mu$–$800\,\mu$ broad. Sporangium oval, 3-6 mm. long and 3-4

mm. broad, velum incomplete, covering ½ to ¾ the sporangium, microsporangium not yet observed, megaspores 'fuscous black' (Ridgeway) when wet and white when dry, 250 μ–400 μ in diam. (average of 100 spores is 320 μ) with prcminent commisural ridges, upper segmenets marked with reticulate branched ridges.

FIG. 3. Megaspores magnified to show the surface makings. × 64.

Hab. Along water margins in shallow depressions in granite rocks. Associated with species of *Eriocaulon*, *Myriophyllum*, and *Illysanthes parviflora*. Government Botanic Gardens, Bangalore, South India. Leg. L. N. Rao, August 6, 1944.

Types deposited in the Herb. Kew, England, Royal Botanic Gardens, Calcutta, and in the Central College, University of Mysore, Bangalore.

Isoetes Sampathkumarani, Spec. nov. Rao.

Bulbus profunde in duos globulos divisus: folia 3-16, in spiram disposita, 1·5-9 cm. longa in immersis, aliquantulum longiora in submersis plantis, gracilia, margine membranaceo ad basim, atque gradatim extenuata in apice, pandentia, subtetragona in sectione transversali, stomatibus nonnullis prope foliorum apicem, 100 μ longis 50 μ latis; peripheralibus fascibus nullis; crystallis acicularibus presentibus; ligula triangularis, longitudine major quam latitudine, magnitudinis 1000-1250 μ × 500-800 μ.

Sporangium ovatum, 3-6 mm. longum, 3-4 mm. latum; vclum incompletum, dimidias vel tres quartas partes sporangii operiens; microsporangium haud visum; megasporæ 'fuscous black' (Ridgeway) cum madidæ sint albæ vero cum siccæ, 250-400 μ in diam., (medietat, mensuratis 100 sporis 320 μ) commisuris prominentibus, superioribus segmentis ornatis aristis reticulate ramosis.

Habitat. ad aquæ marginem in vadis in saxis graniticis, associata specibus Eriocauli, Myriophylli atque Illysanthis parviflorae, in Govt. Bot. Gard., Bangalore, S. India, leg. L. N. Rao, August 1944.

Typus positus in Herb. Kew, in Anglia; in Roy. Bot. Gard., Calcutta, atque in Centr. College, Bangalore.

Department of Botany,
Central College,
Bangalore,
October 25, 1944.

L. NARAYANA RAO.

Baker, J. G., *Handbook of Fern Allies*, 1887. Bharadwaja, Y., "The Occurrence of *Isoetes* in India," *Curr. Science*, 1935, **3**, No. 7. Eaton, A. A., *Gray Manual, edtn.*, 1908, **7**. Mahabale, T. S., On a new species of *Isoetes* in India, *Curr. Science*, 1938, **7**, No. 2. McCann, C., "Occurrence of *Isoetes coromandalina* L. in Bombay Presidency", *Jour. Bom. Nat. Hist. Soc.*, 1934, **37**, No. 2. Pfeiffer, N. E., "Monograph of the Isoetaceæ", *Ann. Miss. Bot. Garden.*, 1922, **9**, No. 1. Sadebeck, R., *Die Naturlichen Pflanzenfamilien by Engler & Prantl.* 1902, Teil.**1**, Abt. 4. Gluck. H., *Die Susswasser-Flora Mittelcuropas*, Heft. 15, 1936.

A NEW VARIETY OF BRINJAL (*SOLANUM MELONGENUM* L.)

IMPROVED Sabour type I brinjal, better known as Muktakeshi Collegia Baigun,* was described in 1936-37,[1] which is breeding true to type. In 1939-40, a new kind of brinjal having long and thin fruits was observed in the Botanical Section, Bihar (1939-40). It was probably thought to be a mutant. The single-plant seed of the above was grown in pure line culture next year and it was observed to be breeding true. It seemed to be a promising variety as it has the same violet colour of S.T. 1 and at the same time it gives more fruits.

In the third year, *i.e.*, 1940-41 besides the study of its pure line culture, the new strain was put under a paired-strip trial for comparison with S.T. 1 in three replications only. In the fourth year, *i.e.*, 1941-42, the new type was put under a replicated trial along with S.T. 1 and the local. In the year 1940-41, though there seemed to be no significant difference in yield between S.T. 1 and S.T. 2 (new type) yet the apparent yield of the latter was decidedly higher than S.T. 1.

YIELD TRIAL

(*a*) *Paired-strip*.—The seedlings of both S.T. 1 and S.T. 2 were transplanted in paired strips in 134′ × 6′ plots in three replications. Distance between plant to plant and row to row was 3′. Usual irrigation and hoeing were given. Brinjal lines were interspersed with chillies with a view to avoid crossing. The crop was excelelent. The summary of results is given below:—

TABLE I

Mean difference in favour of S.T. 2	1762·7
Standard deviation of the difference	740·14
Standard error	427·8
Fisher's '*t*'	4·12
Expected values of '*t*' ..	9·925 at 1% level 4·303 at 5% level

No significant difference in yield was observed statistically between the two types. But the apparent yield of S.T. 2 (new ype) was found to be 392·8 maunds per acre against 243·8 maunds per acre of S.T. 1 (*Annual Report of the Botanical Section*, 1940-41).

(*b*) *Varietal Yield Trial*.—With the above idea of promising yield, a varietal trial with the above Sabour types was conducted against the local prevalent type in six replications of 1/71st acre plot. The plant to plant and row to row distance was normal. No segregation was observed in Sabour types. Observations on stand after transplanting, stand at

maturity and yield were taken and analysed statistically. No significance was observed on the stand after transplanting among the varieties tried, showing that post-transplanting casualities were not serious in any variety. Most of the variations were due to the error of random sampling though the one due to blocks was of the same order as that due to treatments.

Stand at maturiy differences between the various varieties were also found to be insignificant. Here also the error variance was nearly twice that due to blocks which was of the same order as that due to treaments.

Yield differences between the varieties were found to be significant at 1 per cent. level of probability. S.T.2 significantly out-yielded S.T.1 and Local which between themselves did not differ significantly.

The yield figures were correlated with that of stand at maturity with a view to see how the varieties behaved on correction for differences in plant numbers. The coefficient of regression was found to be 32·3 and the significance come acrcss in the crude analysis was maintained even on correction.

TABLE II
Mean square for various components of variations for different characters

Due to	D F.	Stand after transplanting	Stand after maturity	Yield	
				Crude	Corrected
Blocks	5	4·6	4·8	115294·1	..
Treatments	2	3·1	4·5	556300·6	542637·25
Error	10	31·6	9·2	26281·8	30718·4
Standard error		4·35	7·4	397	429·3
Standard error %		1·25	2·2	5·78	6·2
Significant difference		..		1250·95	1352·72

Yields compared

	S.T. 2	S.T. 1	Local
Crude	8922 Chataks	6268 Ch.	5420 Ch.
Corrected	8954 „	6430·3 Ch.	5358·5 Ch.
Yield per acre of fruits	163·5 Md.	116 Md	100·5 Md.

I am greatly indebted to Dr. R. H. Richharia, M.SC., PH.D. (Cantab.), Economic Botanist, Bihar, for the facility and suggestions provided for this work and I also thank Mr. M. P. Singh, Assistant Economic Botanist, for help in statistical matters.

Agricultural Research Institute,
Sabour, RAM SAGAR ROY.
October 9, 1944.

* The type was improved by the Sabour Agricultural Research Institute popularly known as Sabour College and so the type is called Collegia.

1. Singh, *T.C.N. Bull. No. 8*, Dept. Agri., Bihar.

ERGOT ON *CYNODON DACTYLON* PERS.

IN the course of the studies on the sugarcane ergot reported by the writer[2] further observations were made with a view to find out the recurrence of the disease. In connection with his observations on the sugarcane ergot in the Philippines Ocfemia[1] states that "with the occurrence of ergot on arrows of seedling cane varieties at Los Banos, Laguna, it seems that the casual fungus occurs on grasses in the Philippines".

Profuse infections of the spikelets of *Cynodon dactylon* Pers. (Fig. 1) by a species of *Claviceps* were noticed by the writer in the months of September and October in the vicinity of sugarcane fields where the ergot

FIG. 1

stages of the sugarcane-ergot had been collected in the previous year. In the size and shape of the sclerotial stages, the ergot on *Cynodon dactylon* very closely resembles the sugarcane ergot. Cultural studies are being made to find out the host relationships.

Dept. of Botany,
Central College, M. J. THIRUMALACHAR.
Bangalore,
October 24, 1944.

1. Ocfemia, G. O., " Notes on some economic plant diseases new in the Philippine Islands II," *Philippine Agric.*, **1931**, **19**, 581–89. 2. Thirumalachar, M. J., "Ergot on sugarcane in Mysore," *Curr. Sci.*, **1943**, **12**, **330.**

REVIEWS

A History of Comparative Anatomy. By F. J. Cole. (Macmillan & Co., Ltd., London), 1944. Pp. viii + 524. Price 30/-.

Dr. F. J. Cole has long been regarded as one of the foremost authorities on the history of comparative anatomy and almost immediately after his retirement from the Chair of Zoology in the University of Reading, he set himself to the stupendous task of making known the great debt our present knowledge of animal anatomy owes to the long array of pioneers who, from the time of Aristotle down to the eighteenth century, have contributed to the growth of this science. He has left much of the eighteenth century and later out of his consideration, for, this comparatively recent aspect of the history of anatomical research is fairly well known and has commanded the attention of a considerable number of recent students. It is the old giants that claim Dr. Cole's attention. In this history of anatomy, as in the history of most branches of knowledge, there is a dark period extending over the first fourteen hundred years in the Christian era, which is bleak and unproductive and which contributed practically nothing to the growth of anatomy, so that, barring the early contributions like those of Aristotle and Galen, the scope of the work covers the productive effort of but a few hundred years.

Dr. Cole must have had the idea clear in his mind for a long time, even as a young teacher, to devote his energies to the historical side of zoological discovery and we will be surprised if his will not be last word on the subject. Imbued with a pardonable enthusiasm for his pet subject, Dr. Cole would desire that History of Anatomy be prescribed in the zoological curricula in our Colleges. It is doubtless that to the young student it may be an interesting escape from the rigours of routine dissections, to delve, however superficially, into the no longer mysterious past of anatomical discovery but to the actual worker, it is of very little consequence since he is not likely to be affected by the ancient and slightly ludicrous atmosphere which such books create. To the historian it has a definite usefulness, yes; but to the research worker, no; because if it is not an exclamation of wonder at the technical skill and painstaking labour of Swammerdam, it would be a smile at the credulous mistakes of Aristotle and both have no place in the pursuit or accumulation of knowledge.

The book differs from all others on a similar theme in putting the work of the man before the man himself, and if the man figures at all (in addition to the appendix where biographical notes are indicated), it is against the background of the contributions made by him. But often, especially in historical characters, it becomes a matter of difficulty to segregate the two and that difficulty Dr. Cole too experiences. But we would not have it otherwise. The young student and worker to whom the book is of special value would not like to divorce one from the other and the personality of the man has as much a fascination for him as his work itself.

A critical examination of the work of the old masters of anatomy shows that any of them would stride like a Collossus in this our modern age as he did in his own, and one finds oneself reflecting whether our modern age could be said to produce more than what the old one did, so far as skill goes; for, skill is largely a matter of the mind and the hand, unlike technique, which is a matter of the machine and the tool. And it is hardly likely to be argued that the mind of the men in the 16th or 17th centuries or the centuries before Christ was any the inferior or less perspicacious than that of the men of the present century and Dr. Cole directs our attention to the masterly dissections of Swammerdam and observes that if Swammerdam could have commanded a binocular microscope, he would doubtless have saved himself much toil and strain but it is doubtful if he would have 'discovered' more.

Two sections of the book, more than the others, deserve the particular attention of the reader. The first, on the Societies and Academies, is a review of the important early publications of the Royal Society and its contemporaries, but more than that, the significant fact is that these Societies initiated a new kind of outlook and a new approach to Biological investigation, *i.e.*, of Discussion and Co-operative effort. The usefulness of this type of approach has been borne out by the avidity with which the original idea has been borrowed by practically every country in the world—resulting more often than not, in an unnecessary and confusing multiplication! But that the idea was a good one has been justified by the results which have been most productive and encouraging and in fact it has completely superseded the old and effete idea of individual and private publication.

The other section is devoted to the history of the foundation and development of the Anatomical Museum which has come to be an integral part of anatomical teaching. Dr. Cole traces the development of the art of preservation of specimens and shows how the modern museum has evolved and diverged from the old.

The most outstanding feature of the book is its illustrations. A book of this kind would be valueless if it were not set against the background of pictorial depiction of the development of anatomical thought and Dr. Cole has been able successfully to collect a great mass of illustrations which are mostly photographs of the original illustrations of the authors themselves,—illustrations which have never before been brought together in a single book and which are as much a credit to the technical skill and perfection of the photographer as to the selective ability of the author.

The book is a life's work, displaying a patient and painstaking accumulation of facts

and their assessment. It is often difficult for a scientist in the modern age to evaluate the work of one in the old but Dr. Cole has been free from this bias, and has brought to bear a searching and at once a sympathetic enquiry to his task. That he has been eminently successful is proved by the fact that he has produced an outstanding contribution to our knowledge of the history of anatomy,—a contribution which will stand unique and unparalleled for a long time.

B. R. S.

Metallurgical Analysis. By V. Gopalam Iyer, B.A., Asst. Prof. of Chemistry and Assaying, Benares Hindu University. Pp. 365,. Price Rs. 12.

This book has been written primarily to meet the needs of the undergraduates in Mining and Metallurgy of the Benares Hindu University. A variety of analytical topics of industrial interest have been dealt with in this book. The first 200 pages are devoted mostly towards the analysis of industrial metals and their alloys like iron, nickel, gold, aluminium, silver and various types of steels. Special attention is paid towards the analysis of different varieties of slags. The next section of the book deals with some technical methods of organic analysis like the proximate and ultimate analysis of coal, carbonisation assay of coal, calorific power of coal, iodine value of caster oil and technical methods of testing lubricating oils. The last 50 pages are devoted to describe a number of miscellanious topics like the analysis of zinc blende, alluminium alloys, qualitative analysis of alloying elements, sampling laboratory reagents, etc. In fact the book serves as a brief notes of the common methods of technical analysis as applied to the Indian Industries.

The book requires a good deal of improvement before it can give full satisfaction to the readers. It is very distressing to find that the book should have 300 items of errata in addition to many not corrected. In the copy sent for the review pp. 2, 3, 6 and 7 are missing while pp. 1, 4, 5 and 8 are duplicated. It can be hoped that the author will not allow these mistakes in the next edition. Some topics on pp. 5, 9, 12, 14, 21, 27 require careful modification. The value of the analytical methods can be improved by giving some common uses of the organic reagents in the estimation of metals.

M. R. A.

Soil Erosion. By Sir Harold Glover (Oxford Pamphlets on Indian Affairs, No. 23, Humphery Milford, Oxford University Press), 1944. Pp. 32. Price As. 6.

Erosion and the resulting decline in the fertility of the soil are among the foremost problems facing the subcontinent of India. Their effects are not confined to the land alone, man and animal suffering as well, due to a decrease in the capacity of the land to support life. There are no statistics of the extent of area affected by erosion, but, even at a low estimate, this will be well over half the total cultivated area of 330 million acres. It is therefore obvious that the control of soil erosion is a task of national importance. Happily, many of the provincial governments have recently begun taking steps to check soil erosion by suitable preventive measures. Constant propaganda is, however, required for the effective carrying out of a progressive soil conservation policy as it is only then that the general body of the people become convinced of the menace of soil erosion. The booklet under review is very successful attempt in this direction. The author has given a lucid exposition of the main factors responsible for soil erosion and the remedial measures necessary to conserve the soil and maintain its productivity. Among the causes of soil erosion are the destruction, mostly by man and his animals, of the forests and of the vegetative covering of the soil, faulty methods of cultivation and the ploughing of unstable slopes. The cure of soil erosion lies in the restoration of the vegetation by afforestation and proper pasture management and in better agricultural practices like terracing, levelling, contour-bunding and the provision of adequate drainage for storm water. The suggestions made by the author for the proper management of forests, pastures and cultivated lands should form an excellent basis for long-term regional planning and this well-written pamphlet deserves therefore to be widely read.

A. Srenivasan.

The Indian Sugar Industry. (1943 Annual). By M. P. Gandhi. (Gandhi & Co., Sir Pherozshah Mehta Road, Fort, Bombay), 1944. Vol. IX. Pp. 350. Price Rs. 6-6-0.

First published in the year 1935, this comprehensive and valuable Annual has come to be looked upon as the only authoritative source of information and data pertaining to all branches, including the legislative and economic aspects of the Indian Sugar Industry.

A new peak of production of sugar was reached during the period covered by the Annual and the author envisages the easy possibility of reaching the target of 1·5 million tons during the impending season.

The magnitude and the economic status of the industry are realised if attention is called to the fact that the production of sugar in the country has been responsible for preventing the substantial drain of about 16 crores per annum and for supporting 20 million agriculturists. An industry of such national importance needs to be consolidated and rationalised to withstand possible competition during the post-war period. The author has focussed attention on problems relating to this aspect of post-war reorganisation of the entire industry. One of the effective methods of stabilising the industry consists in the economic utilisation of its bye-products. This aspect has not received any serious attention. Excepting for the utilisation of molasses for the production of power alcohol, no other bye-products are now being produced. The institution of an acoustical engineering laboratory and the founding of a National Collection of Type Cultures, both at the Indian Institute of Science, it is hoped, will stimulate research directed towards a rational utilisation of the bye-products. The Annual deserves the earnest attention of not only those concerned with post-war industrialisation but also those interested in the continued prosperity of the most important and vital of our national industries.

THE CENTRAL IRRIGATION AND HYDRODYNAMIC RESEARCH STATION

THE Annual Report of the Central Irrigation and Hydrodynamic Research Station, Poona (Research Publication No. 6 1944) is a record of the work done by the Research Station during the year 1941-42. It includes an index of the research work carried out during 1937-42. The contents of the volume are divided into three groups, (1) Introduction, (2) Specific Experiments and (3) Basic Experiments in connection with research into specific problems. During the year under report, 27 investigations were under progress, 15 of them being specific in character and twelve basic.

Divergence from Regime in Stable Channels in Alluvium forms the subject of a note in the Report drawing attention to the marked effect of sand-charge on slope and dimensions and shows that the 'divergence from regime dimensions' is due to divergence from 'regime balance between discharge, grade and load'. A number of sand channel experiments carried out with a view to get the dimensions of small stable channels emphasise the great difficulty of reproducing natural, stable channels under model conditions and indicate, that provided there is sufficient slope for free bed movement the final slope of the channel will almost exactly be the same, provided the bed-mix remains the same, even though the initial slope is considerably too steep or only a little steeper than the natural slope. Safe levels at which stone protection may be maintained round piers were determined by experiments conducted on a model of the Hardinge Bridge in which high level pitching at piers 2 and 3 was responsible for the deep scour-holes downstream of the second span. From experiments on models of submersible bridges it is found that for the same shape of obstruction to flow, the coefficient of 'form drag' (impact losses) for a pier was slightly less than that for a slab.

Exclusion of silt from canals has been for long a subject of experimental study at the Station and the adoption of methods indicated by the experiments at the Station has greatly reduced in several instances the silt trouble. The Sukkur Barrage Canals have been for years the subject of model experiments at the Station. The North-Western Cannal was in great danger of heavy silting from 1935 onwards, the depth of sand on the bed being over 4 feet at 2,000 feet from the Head and in 1938 there was 4 to 5½ feet of silt on the bed almost continuously and the future of the Right Bank Canals was threatened. Investigations conducted on two river models with horizontal scales of 1/300 and 1/150 with various vertical exaggerations and on several part-models at the Station led to the construction of a new Right Bank Channel which has successfully removed the menace to the Right Bank Canals. Canals under the Eastern Nara, the Mithrao Canal in 1933–34 and the Khipro Canal in 1941 have been rid of the silt trouble as a result of adoption of designs evolved at the Station. Methods of excluding sand from the Sarda Canal and from the Canals under Son Anicut at Dehri (Behar) continued to be the subject of model investigations.

Prevention of erosion occurring at several points along the foreshore of the Hooghly above Calcutta is another subject that is being examined on tidal models. In a note are indicated steps likely to retard the rapid westerly movement of the Kosi River carrying a very heavy charge of detritus and white sand, flowing over a wide stretch of country in a number of shallow channels and moving towards the West for hundreds of years. The note on siphon spillways deals with experiments conducted on a 1/10 scale model of Jamshedpur Siphon Spillway, with the usual air-inlet omitted, as this delayed priming and reduced disacharge, and a depriming device introduced. The new design primed with a small head and had a very much higher coefficient of discharge than the Indore type.

The Annual Report contains useful and instructive information on subjects of interest to the irrigation engineer. C. GOPALAKRISHNAN.

FREEDOM FOR THE SCIENTIST

THE ideal to be aimed at in the development of scientific research is not mechanization of the whole army of workers, for there can be no reasonable doubt of the dreary mediocrity that would follow or of the scientific genius that would fail to flower. Imagine Newton, with no leisure for physics or mathematics, compelled to spend his days devising new methods for assaying bullion, Faraday commanded by Gladstone to discover 'something useful', Einstein instructed by a government department to check the tables of seven-figure logarithms! That these are not tendentious exaggerations of what might happen is abundantly witnessed by the records of all governments in all countries and at all times. Let us indeed have more co-operation, more pooling of information, more purposeful and economical direction of research, but let us resolutely withstand the deadening fetters of bureaucracy.

Freedom for the scientist to follow his own bent is, in fact, the *sine qua non* of vigorous scientific progress. If an individual scientist add to our knowledge of natural phenomena, he has justified his existence, even if the facts he discovers are of no apparent use to the community. No knowledge of Nature is inherently useless, and no one can say that the seemingly trivial observation may not become significant. Cavendish's eighteenth-century bubble of argon was a chemical *object d'art*; to-day the applications of this gas are so extensive as to necessitate its extraction on an industrial scale. Any, happily, there are still those who inquire into the nature of things because 'all knowledge and wonder (which is the seed of knowledge) is an impression of pleasure in itself'. (*Endeavour*, 1942, 1, 49.)

SCIENCE NOTES AND NEWS

The Nobel Prize for Physics for 1944 has been awarded to Professor Rabi of Columbia University, New York, for his "resonance method for the registration of the magnetic qualities of the nucleus of the atom." The Physics Prize for 1943 goes to Professor Otto Stern of the Carnegie Institute of Technology, Pittsburg, Pennsylvania, for his contribution to the development of the molecule ray method and the discovery of the magnetic momentum of proton.

The Nobel Prize for Chemistry for 1943 is awarded to Professor Georg von Hevesy of Stockholm, for his contributions on the use of isotopes as indicators in studying chemical processes. It may be of interest to add that Prof. Hevesy was invited by Sir C. V. Raman to occupy the Chair of General Chemistry at the Indian Institute of Science. The Chemistry Prize for 1944 has been reserved until next year.

The award of the Nobel Peace Prize has been held over until next year.

The Nobel Awards for 1943 and 1944 were announced at Stockholm on the 26th October, 1944. The prize for Physiology and Medicine for 1943 is shared jointly by Professor Henrik Dam, Copenhagen, and Professor Edward Adelbert Doisy of Saint Louis, Missouri. The same award for 1944 is shared jointly by Professor Emeritus Joseph Erlanger of St. Louis and Professor Herbert S. Gasser of Rockefeller Institute, New York.

Inaugurating the Science Association of the Lucknow University on the 9th November 1944 Sir C. V. Raman declared that non-co-operation was a powerful weapon against the misuse of science. Scientists should be prepared to be crucified in the defence of science rather than allow it to be misused by imperialists and dictators as an instrument of destruction of human life and culture.

Addressing the Madras Philosophical Association, Sir S. Radhakrishnan said that in a world growing more and more "addicted to Science," the need for Philosophy was no less great. If one asked why it was we found ourselves in our present position and why it was that civilisation to-day had come to be called "mustard gas and flying bomb civilisation", one would get the answer that it was due, not to lack of scientific enlightenment, technical organisation, qualities of daring, readiness to sacrifice or suffer or of social conscience, but to all these being harnessed to wrong ends. The greatest need of the world to-day as Livingstone put it, was "a proper philosophy". Whether a philosophy was true or false, whether its interpretation was correct or incorrect would depend on the values adopted in the interpretation. Were the sciences of biology, economics or politics enough to interpret man? Was there not need for something which interpreted him not "as an item in the world of experience" but as one with a soul and a subjective attitude not adequately translatable in terms of those sciences?

The Chemo-Therapy unit having proved its efficacy, the Government of Bombay have decided to convert it into a parmanent Department of Chemo-Therapy. The *Haffkine Institute, Bombay*, has for some time been undertaking research work on treatment of disease by synthetic chemistry, and has discovered a very important drug for the treatment of plague, sulphathiazole. A new process has been invented for preparing of the drug and the patent office has accepted the patent. When the patent is sealed it will be possible to make the drug available to the Health Department and the Medical profesesion at a very reasonable price. Preparations have also been made to manufacture atebrine and plasmoquine, as the supply of these drugs from abroad has been temporarily cut off.

The Court of the *Indian Institute of Science, Bangalore*, has recommended to the Council the expansion of the heavy engineering side of the Department of Electrical Technology in the Institute. Sir M. Visvesvaraya has been re-elected President of the Court for 1944–45.

The Aligarh Muslim University has received a sum of Rs. 1,00,000 from the Nawab of Junagadh for a proposed Medical College. It has been decided to start from October 1944 a College of Physical Education and Recreation which will have a one-year course open to educated men who want to make Physical Education a career in life.

The Osmania University has acquired a unique collection of manuscripts which had been in the possession of the late Hakeem Mohamed Qasim. The collection consists of 3,000 palm-leaf and paper manuscripts dealing with all branches of Hindu learning. 220 of these deal with Vedic literature and 305 with the six systems of Indian philosophy. The rest comprise treatises on Puranas, Dharmashastra, music, medicine, astronomy, astrology and lexicography. The greater part of the works in Telugu, found in this collection, is by the poets and writers of the Telingana area in Nizam's Dominions. Two unique manuscripts supposed to be in Brahmi character, not yet deciphered, are believed to belong to a period earlier than 300 B.C.

A group of Indian engineers and businessmen in America, believing that "the mother country's first need is industrialisation," have formed in New York an organisation called the India Technical Association, whose object is to promote Indian–American relations in aid of their programme. About fifty Indian scientists,

technologists and businessmen in America have so far joined the movement.

At the invitation of the National Academy of Sciences of America the Indian Scientists Mission is leaving for New York early in December. Arrangements are complete for establishing a permanent scientific mission in London. Similar organisations are expected to be established both in Washington and Moscow.

Sir Nelson Johnson, Director, Meteorological Office, Air Ministry, has arrived in India on a mission on behalf of the Royal Air Force. His purpose is to consider how the meteorological staff, now becoming available in the West, can be best employed to work for the Air Forces, in conjunction with the India Meteorological Department.

The Annual Report of the Indian Association for the Cultivation of Science for the year 1943 includes a brief resume of the research work carried out in the Laboratory by Dr. K. Banerjee (the newly appointed Dr. Mahendra Lal Sircar Professor) and his associates. The original investigations can be broadly classified under the following headings:—(1) X-rays, (2) crystal magnetism and (3) Raman effect. The main results of these investigations are contained in the seven papers published during the year under review.

The Forest Research Institute, Dehra Dun, has designed a simple chamber (described in Indian Forest Leaflet No. 65) for the conditioning of finished plywood. The drying room is fitted with steam pipes below the floor and the sheets of plywood are stacked vertically on trolleys above it. There are inlets for fresh air and outlet chimneys for exhausting the moist air from the room. It is estimated that freshly manufactured plywood will take 24 hours to condition and during this period its moisture content will decrease from about 20 per cent.

The Central Government have appointed a Mica Enquiry Committee to enquire into the immediate as well the long-term problems of mica mining industry. The Committee will be assisted in their investigations by assessors from the mica trade and industry and by technical advisers from the Geological Survey of India and the Board of Scientific and Industrail Research. While the Committee will generally enquire into and report on all problems relating to the mica industry and its present and future developments they will specifically examine and report on immediate problems relating to the Mica Control Order, 1940, both in regard to war production and long-term policy, and the review of any orders that may have been passed by Government in connection with that Order; the present system of marketing—both inland and abroad; standardisation of quality; the extent to which alternative sources of supply may have jeopardised or are likely to jeopardise the position of India as the principal supplier of muscovite mica; the extent to which other materials, that may be used as substitutes for mica, may have displaced or are likely to displace mica from its uses in the industry; increased utilisation of mica in India for the manufacture of finished goods; methods of development with special reference to research, conservation, mining, processing, marketing and meeting competition; and the desirability of setting up a suitable machinery whether by the appointment of a Central Mica Committee or otherwise to watch the interests of the mica trade and industry.

With a view to giving encouragement to the production of jute in the Argentine by facilitating the obtaining of seed of good quality in sufficient quantity, the Ministry of Agriculture has arranged a system of inspection of the growing crops on lands of owners who apply for registration by the Ministry.

Hajee Ismail Cassik Adam, a leading Indian merchant from Pretoria, has donated £7,500 towards the foundation of a Scholarship Fund for Indian students at the Witwaterstrand University. The scheme for such a fund was inaugurated recently by the High Commissioner for India. It is hoped the Fund will eventually reach £30,000. Adam was educated in Pretoria, and has travelled in England and the United States. Since his return, he has taken a prominent part in the public life of the Indian community. His father, the late Khan Bahadur Hajee Cassim Adam, as the recognised leader of South African Indians, rendered notable service to the Indian community.

The Fifth All-India Pharmaceutical Conference and a Pharmaceutical Exhibition will be held in Bombay at the University Buildings on the 21st, 22nd and 23rd December 1944. The Vice-Chancellor of the University of Bombay will inaugurate the Conference and the Exhibition.

The principal aim of the Conference is to bring together people interested in pharmaceutics and pharmaceutical trade under one canopy with a view to divising ways and means to develop the profession and the industry on a scientific basis. Recent developments in pharmaceuticals and the effect of future Pharmacy and Drug Legislation in India form the subjects of two Symposia. Eminent scientists and industrialists will partake in the discussions.

The Indian Pharmaceutical Association (Bombay Branch) invites the whole-hearted support and co-operation of every one interested in the profession of pharmacy to make both the Conference and the Exhibition a great success.

Full particulars regarding the conference and the exhibition can be had from the Hon. Secretary, The Fifth All-India Pharmaceutical Conference, Department of Chemical Technology, Matunga Road, Bombay 19.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory during the month of October 1944, there were nine of slight and three of moderate intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T. H.	M.	Epicentral distance from Bombay (Miles)	Co-ordinates of epicentre	Depth of focus (Miles)	Remarks
3	Slight	03	00	4320			Epc.: Near Japan.
3	Slight	22	37	3285			
5	Slight	23	27	5625			
6	Slight	00	03	5575			
6	Slight	00	09	2830			
6	Moderate	09	05	3230			Epc.: In Turkey. Felt i Istanbul, serious damag in Smyrna and Ayvalik.
14	Slight	03	19	1360			
15	Slight	02	46	3935			
18	Moderate	01	07	1015	Lat. 30°·7 N., Long. 82°·5 E. in Tibet.		
24	Slight	06	10	10040			
29	Moderate	06	42	1005	Lat. 30°·8 N., Long. 81°·8 E. near Manas Sarovar.		
29	Slight	21	47	960			

MAGNETIC NOTES

Magnetic conditions during October 1944 were slightly more disturbed than in the previous month. There were 16 *quiet* days, 14 days of *slight* disturbance and 1 day of *moderate* disturbance, as against 8 quiet days, 20 of slight disturbance and 3 days of moderate disturbance during the same month last year.

The quietest day during the month was the 9th and the day of the largest disturbance the 11th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days: Slight	Disturbed days: Moderate
2, 4, 5, 7–10, 17–22, 27, 28, 30	1, 3, 6, 12–16, 23–26, 29, 31	11

No magnetic storms occurred during the month of October in the years 1943 and 1944.

The mean character figure for the month of October 1944 was 0·52 as against 0·84 for October last year.

M. PANDURANGA RAO.

At the meeting of the Council of the National Institute of Sciences of India held on the 30th October 1944 the following were duly declared to have been elected Ordinary and Honorary Fellows of the National Institute:—

Ordinary Fellows: (1) Prof. Bashir Ahmad, Ph.D., Professor of Organic and Biochemistry, Panjab University, Lahore; (2) Prof. N. M. Basu, M.A, Senior Professor of Physiology, Presidency College, Calcutta; (3) Dr. P. N. Bhaduri, Ph.D., F.L.S., Lecturer in Botany, University College of Science, Calcutta; (4) D P. K. Bose, D.Sc., Deputy Director of Produc tions of Drugs and Dressings, Department Supply, New Delhi; (5) Dr. Hamid Kha (Bhatti), LL.B., Ph.D., Game Warden, Panja Lahore; (6) Dr. S. R. Khastgir, Ph.D., D.Sc F.R.S.E., Reader in Physics, Dacca Universit Dacca; (7) Dr. M. G. Kini, M.C., M.B., M.ch F.R.S.E., F.R.C.S.E., Surgeon and Superintenden Stanley Hospital, Madras; (8) Dr. Subod Mitra, M.D., F.R.C.S., F.R.C.O.G., Associate Profes sor of Midwifery, Carmichael Medical Colleg Calcutta; (9) Dr. G. Panja, M.B., D.Bact., Pr fessor of Bacteriology and Pathology, Scho of Tropical Medicine, Calcutta; (10) Prof. Sanjiva Rao, Ph.D., Head of the Department Chemistry, Mysore University, Bangalor (11) Mr. S. N. Roy, M.Sc., Lecturer in Sta istics, Calcutta University, Calcutta; (12) D B. N. Uppal, Ph.D., Plant Pathologist to Goverr ment of Bombay, Poona.

Honorary Fellows: (1) Sir Henry Halle Dale, Kt., O.M., President, Royal Society London; (2) Prof. A. V. Hill, O.B.E., Sc.D., M. Secretary, Royal Society of London.

We acknowledge with thanks receipt of th following:—

"Journal of the Royal Society of Arts," Vo 92, Nos. 4666-72.

"Journal of Agricultural Research," Vol. 6 Nos. 7-10 and 12; Vol. 69, No. 1.

"Agricultural Gazette of New South Wales Vol. 55, Pts. 5-7.

"Indian Journal of Agricultural Science Vol. 13, Pt. 6.

"Biological Reviews," Vol. 19, No. 2.

"Journal of the Indian Botanical Society Vol. 23, Nos. 1-2.

"Annals of Biochemistry and Experiment Medicine," Vol. 4, No. 1.

"Journal of the Indian Chemical Society Vol. 21, Nos. 4-5.

1358-44 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D. for The Current Science Association, Bangalore

CURRENT SCIENCE

Vol. XIII] DECEMBER 1944 [No. 12

THE INDIAN ACADEMY OF SCIENCES*

THE first annual meeting of the Indian Academy of Sciences was held at Bombay. Once again we meet in the Bombay Presidency, this time in the historic city of Poona, associated in our minds with one of the most striking periods in Indian history and to-day one of the chief centres of culture and learning in our country. To our hosts who have taken it upon themselves in these difficult times to invite us to their city and thereby made it possible for us to meet here, our grateful thanks are due.

Ten years is not a long period in the life of an individual, much less in the history of an institution. Infantile mortality is, however, notoriously high in India. Hence, it is not inappropriate for me to draw your attention to the fact that this is our tenth annual meeting and that the scientific *Proceedings* of the Academy are now running in the twentieth volume, both in the A and B series. The usefulness of these *Proceedings* as a forum for the publication to the world of the results of the scientific investigations of our Fellows and their collaborators has been abundantly demonstrated. The *Proceedings* have appeared in an unbroken sequence and with unfailing punctuality on the last day of every month ever since July 1934 which was the date of the first issue. This is a record of which we may feel justifiably proud.

The Academy is a body of scientific men interested in their work and especially in the advancement of knowledge by original research. It is an organisation which can be of immense service to science and to the country in various ways. if it is adequately supported and encouraged. I think I am speaking for all our Fellows throughout India when I say that not only are we capable of rendering such service, but are also willing to do everything in our power to demonstrate the social value of scientific research in our country. Elsewhere in the world, the Academies of Science are not merely publishing organisations for scientific research, but also function as active promoters of scientific research by building and equipping laboratories and maintaining professors and students to work in them. It is my considered opinion that the future of science in India depends to a very great extent on such a development taking place in our country and not upon the multiplication of official laboratories staffed by armies of Government servants. The history of science has demonstrated over and over again that the choicest fruits of scientific research fall into the hands of those men who seek for no reward except the discovery of truth. The mind that seeks to explore Nature and discover her secrets and the mind of a bureaucrat are as poles asunder.

It is my earnest desire that the Indian Academy of Sciences should function in the manner I have indicated and actively sponsor scientific research in a group of institutions covering the whole field of natural knowledge, from pure mathematics and astronomy at one end, physics, chemistry and mineralogy in the middle and physiology and genetics at the

* Part I of the Presidential Address by Sir C. V. Raman at the Poona Meeting, 27th December 1944.

other end. Such a group of institutions linked together and working under the general guidance of the Academy would serve as the vanguard of science in India, marching into the unknown, blazing a trail for others to follow and pointing a way to the practical applications of science. Such a scheme may seem a colossal one, but to my mind it is entirely practical and indeed realisable in a reasonably short time, if only our wealthy men could give a generous helping hand. Nothing would pleace me more than to be able to devote myself to the realisation of this idea and of its practical consequences.

Meanwhile, there is one small step which our Fellows, if they so choose can help the Academy to take immediately, and that is to provide a permanent habitation for our offices. A circular letter has been issued to our Fellows in this connection, and I greatly hope that it will meet with an immediate and generous response from them.

* * *

I shall devote the rest of this address to a topic which is surely familiar to you all. Who does not know the classic illustration of the thermal expansion of solids which is the fitting of the iron tyre to a cart-wheel by first heating it up and then placing it in position? To know that a solid expands when heated is, however, only a first step in knowledge. To specify its magnitude and offer an explanation of the phenomenon and to predict its course over a wide range of temperature are the deeper problems of the subject.

The solids familiar to us in our daily lives are of complex structure and their thermal behaviour is naturally of great practical importance. But to the physicist who seeks to understand the fundamental aspects of the subject, the ideal materials to study are those which are relatively simple, both physically and chemically. The best choice is that of a well-developed single crystal, while such substances as pure metals, diamond, rock-salt, flourspar, calcite and quartz offer the greatest promise of a successful theoretical interpretation.

It is easy enough to observe and measure the expansion of a long bar when heated up sufficiently. When we are working with single crystals, however, it is usually possible only to get rather small specimens. The accurate determination of thermal expansion then becomes a more difficult experimental problem. The celebrated French Physicist, Fizeau, was the first to use the delicate optical method known as the interference of light for such studies. For this purpose, he worked with specially cut and polished specimens of various crystals. During a visit to Paris in the year 1937, I was fortunately enabled to discover and purchase several of Fizeau's original specimens. The collection now forms one of the most highly prized treasures in my crystal cabinet.

Another and very beautiful method which is extensively used at the present time is based on the use of X-rays. The angle at which such rays are reflected by the atomic layers in a crystal depends on the spacing of these layers, and alters with the changes of spacing produced by the expansion or contraction of the crystal. Very small quantities of the substance are sufficient for this method, and it is also possible to use material in the form of powder. Further, by choosing the conditions such that the X-rays are reflected almost exactly backwards, very small changes in the atomic spacing produce a detectable change in the angle of reflection. The method is then both sensitive and accurate. An important aspect of the technique of the X-ray method is the maintenance of the material at the desired temperature without altering the temperature of the rest of the camera. Recently, Dr. R. S. Krishnan has reported an interesting modification in which this difficulty is avoided by the use of a divergent beam of X-rays. The X-rays fall upon a chosen face of the crystal, and the sharply-defined reflections given by it are recorded on a photographic film placed at any desired distance. Even a small expansion then produces an observable shift which can be accurately measured. It is important to hold the crystal in such a way that it does not rotate appreciably when heated or cooled, and this can be controlled by a second photograph in a different setting of the crystal. In this way, Dr. Krishnan has studied the thermal expansion of diamond over a fairly large range of temperatures.

Except in the case of a crystal belonging to the cubic system, its expansion is not the same in all directions, the nature of the differences being determined in a general way by the symmetry of the crystal, and more particularly by its internal architecture. To determine the thermal behaviour of a given crystal completely, it may thus be necessary to determine the expansion in several directions. When it is recalled that the rate of the thermal expansion per degree centigrade itself usually changes with temperature, and that this may again be different for different directions, it will be realised that a complete specification of the thermal behaviour of a crystal of low symmetry over a wide range of temperature may be somewhat complicated. Indeed, some crystals, *e.g.*, calcite, actually contract instead of expanding in certain directions when heated. It is a special advantage of the X-ray method in which powders are used is that the changes in all the atomic spacings of the crystal lying in many different planes are simultaneously recorded, thereby reducing the labour involved in the study of a particular substance.

As already remarked, the thermal expansion of a solid per degree centigrade is far from being constant over any appreciable range of temperature. The changes in the rate of expansion are particularly striking at low temperatures such as those of liquid-air. There are, however, some crystals in which the accelerated thermal expansion is noticeable even at and above room temperature. Diamond is a particularly conspicuous example, as is shown by Dr. Krishnan's recent studies with it.

BASIC PRINCIPLES FOR PLANNING THE DEVELOPMENT OF INDIAN FRESH-WATER FISHERIES

BY

Dewan Bahadur DR. B. SUNDARA RAJ, M.A., Ph.D.

(Fisheries Development Officer, U.P., Lucknow)

THE acute shortage of meat and other animal food of all kinds caused chiefly by the unprecedented demand made by the War and the consequent 'Grow More Food' Campaign has brought to prominence the much neglected fishing industry as a source of food supply. The urgent need to develop the industry has begun to receive the attention of the authorities concerned. Both independently and recently at the instance of the Government of India, provincial and State Governments have set themselves to the task of actively planning the development of their inland fisheries with the twofold object of (1) immediate exploitation to meet the present demand and (2) organizing it on scientific lines as a post-war national food industry.

For planning the development of Indian Fisheries on sound scientific lines, expert advice is essential. The Indian fishing industry is primitive and in the hands of a poor and illiterate caste, cannot provide leading businessmen such as are available in more advanced countries, who could be consulted for planning development, while scientists with academic qualifications in fisheries science and practical experience are practically absent. The greatest obstacle, therefore, to successful planning in India is the absence of technical advice and guidance.

In every scheme that has come to my notice so far, emphasis is laid on increased production and marketing, but the all-important conservational aspect of development which should precede intensified exploitation if production is to be sustained, is paid little or no attention. Even the Government of India circular letter No. F-8-5/44, dated 26th May 1944, has failed to mention the paramount importance of conservancy operations while it rightly emphasises intensive production by improved fishing, culture and marketing to meet the present demand.

The fresh-water fisheries of India in the strict sense comprise those of:—

(1) Rivers and their tributaries.
(2) Natural lakes, Beels or Jheels.
(3) Canals.
(4) Artificial reservoirs for irrigation, power or flood-protection.
(5) Small irrigation tanks.
(6) Village ponds.

By far the largest and the most important fisheries are those of Nos. (1) to (4). Of these No. (1) is the *primary source* of our best food-fish—Rohu, Katla, Mirgal, Mahseer, Bachua, Tengra, etc., and it is from the rivers chiefly that all other sources are replenished. From the scientific and economic point of view, therefore, the rivers require the first and the most careful attention, if the future of the fisheries is to be safeguarded and their permanent improvement is to be effected.

PLANS FOR DEVELOPING FRESH-WATER FISHERIES

Fisheries unlike Agriculture or Animal Husbandry depend primarily upon exploitation of natural wealth. Fisheries are more akin to forestry inasmuch as we usually reap where we do not sow. In developing fresh-water fisheries, therefore, the technical operations involved may be summarised under three main heads:—

1. Conservation.
2. Culture.
3. Exploitation.

For all three alike, research and investigation are indispensable. This may perhaps be made clear by three simple examples. The conservation of fisheries depends on a precise knowledge of the existing stocks of fish, their breeding grounds, seasons and habits, which is the result of continuous and detailed observation. Likewise pisciculture, which is a highly technical fishery operation, involves an intimate knowledge of the breeding habits, eggs and early stages of growth of each fish, for which again patient study, accurate observation and delicate manipulation are essential to success. Even for exploitation and marketing from capture to the finished product on the market, biological, chemical and industrial research is needed at every stage.

1. *Conservation.*—The rivers being the primary source of our chief food-fish their conservation should receive the immediate attention in any plan of development, specially as exploitation has been intensified without any reference to the capacity of our rivers. To cite one example which as Fishery Development Officer in the U.P., I had occasion to investigate this summer: From a small section of the Ganges between Allahabad and Benares, "about 150 miles" over 1,000 maunds of fish were being exported every month, over and above some 3,000 maunds sold locally in Allahabad and a similar quantity in Benares. If fish caught in intermediate towns along the river is also taken into account, 10,000 maunds a month is a conservative figure for this stretch of the river. The U.P. Government, at my instance, placed a ban on the export as we had no precise knowledge of the stock of fish in the river or of its productivity, and 10,000 maunds was a strain on any stretch of river, specially as only deep pools existed here and there in the hot weather and these were netted to extinction by contractors who were profiteering on the great disparity in prices prevailing in the U.P., Bombay and Calcutta markets. Their production cost was found to be Rs. 8 a maund at Allahabad as against a sale price of Rs. 80 per maund in Calcutta and Bombay. At present we have no machinery by which to assess the exact effects of this intensified exploitation on the rivers which are our primary source of fish. It is, therefore, the duty of

those who undertake planning to provide an adequate machinery for the all-important task of assessing the stocks and the productive capacity of the rivers. Fisheries science in recent years has made rapid advances. Biometrical, statistical as well as other special methods have been evolved by fisheries science for the elucidation of what may have been considered insoluble problems before, such as the estimation of the stock of fish even in the open sea. The task of estimating the stock in rivers and ascertaining their increase or decrease from time to time should not present insurmountable difficulties. An adequate machinery for such a task utilising all the available technique of the fishery Biologist should form an integral part of scientific fishery organizations to be set up in the Provinces and States. The U.P. plan, therefore, provides a field organization of observers to collect and compile data, a qualified headquarters Laboratory and staff to study this material continuously, draw conclusions and formulate measures, and a preventive staff to carry such measures into execution. The conservancy measures usually adopted are:—

(1) Restriction of mesh of nets and other approved methods of capture.
(2) Prohibition of wholesale destruction by poisoning or dynamite, etc.
(3) Prohibition of capture of young fish or breeding fish generally.
(4) Closure of sections of rivers constituted as sanctuaries throughout or for a part of the year.

The choice and application of any of these except No. (2) will depend on local conditions.

2. *Culture.*—Conservation of the natural resources by itself, is insufficient for maximum fish production. Cultural methods, breeding, rearing, stocking, etc., throughout the agency of fish farms are necessary to supplement nature, specially when intensive exploitation is contemplated. Stocking is particularly required for tanks and land-locked waters which are likely to be completely fished out. Since rivers are the primary source of supply of indigenous fish, their exploitation beyond the limit of natural recovery must always be watched and prevented. On the other hand, tanks and other land-locked waters can be completely fished as the supply can be replenished by stocking. Even where tanks are fed by river channels, an adequate number of fry of suitable food-fish rarely reaches the tanks annually, while invariably predaceous fish obtain access to the tank. Eliminating predaceous varieties and ensuring an adequate supply of fry of food-fish manuring, correcting defects in soil and water and providing an abundant supply of weeds and other food for fish, are the necessary cultural operations if the tanks are to be made to yield their full quota of fish.

Fish culture is perhaps the most technical and specialised of fishery operations. Experience has shown that the spawn and fry of indigenous food-fish can be obtained in sufficiently large numbers from suitable areas in the rivers. It is well known that fish are prolific; a million eggs or more are produced by one breeder (carp specially) at one time. This is nature's provision to counteract destruction by numerous enemies and by an adverse environment. Under natural conditions, only a small proportion of the eggs hatch and a much smaller number of the fry survive. If advantage is taken of this abundance of eggs and fry during the breeding season and they are secured and reared in specially designed ponds and stocked in tanks and Jheels much of the natural wastage in the rivers can be prevented, while the high cost of artificial fecundation and hatching of eggs in expensive hatcheries, is at the same time avoided. For the indigenous fish Rohu, Katla, Mirgal, etc., therefore, all that is needed is to provide nursery ponds in suitable places along the rivers, collect the spawn or fry from the river at the proper time and rear them to the fingerling stage for a few weeks and distribute them to tanks and Jheels after these receive their annual supply of water.

Besides indigenous fish, new and improved varieties of food fish have been introduced and have proved of great advantage in Ceylon, Madras and elsewhere. It is perhaps not very well known that even rainbow trout and brook trout have been grown in ponds. The Mahseer of the Kumaon Hills have been found to breed in land-locked lakes. Another fish which has yielded remarkable results in the Mirror carp, first introduced into Ceylon and recently introduced by me into the Nilgiris. It is a prolific breeder and grows rapidly in ponds and tanks on the hills. The Chinese have probably developed carp culture to perfection. They not only raise carp by intensive feeding with grass and other vegetable matter in ponds, but concurrently raise a subsidiary crop of a different variety of carp which subsists on the faeces of the former variety. This type of intensive culture has been introduced and practised by Chinese settlers in Singapore and should, therefore, be worth trying in India. Gourami is another exotic fish which has given satisfactory results in the South. While it thrives in the tropics up to the latitude of Calcutta or Bombay, it has not been a success further north.

There are also innumerable technical problems varying with the locality, kinds of fish, climate, etc., that require research and investigation before successful piscicultural practice for any Province could be outlined. These investigations relate to the spawning season, breeding habits, character of eggs and fry, rate of growth, the food of the fish at all stages both natural and artificial, the nature of the soil and water and remedial measures for defects in these, suitable weeds and pond-snails and other aquatic life, etc. Besides there are always a number of miscellaneous problems such as wholesale fish mortality which sometimes occurs, infectious diseases, pollution of water, parasites, etc., which should also receive attention.

To deal adequately with all the above problems a central fish farm for research designed on the latest model is necessary. The choice of the site of a fish farm depends on the availability of spawn in the river—they can only be obtained from a few places which have to be searched for—good soil, abundant flowing water, good communications and sufficient low-lying Government land to avoid cost of

acquisition and excessive expenditure on excavating ponds.

3. *Exploitation.*—It has been shown that river fisheries are of supreme importance to the whole scheme of inland fishery development and, therefore, require to be carefully safeguarded by an adequate conservancy and observation staff. A very large proportion of the fish on the markets I have visited comes from the rivers, giving livelihood to large colonies of river fishermen. The scheme of exploitation, therefore, contemplates bringing these fishermen and their operations under the control of Government. To ensure an adequate supply of fish at reasonable rates in important consuming centres, Government may have to launch schemes of capture and supply at least for the duration of the War. In most Provinces and States Government being the largest owners of fisheries, even after the War, if the local trade is incapable of immediate improvement and co-operative agencies cannot be organized, Government will have to initiate fishing and marketing themselves. It should also be explained here that though the Government are the chief producers there is no intention of supplanting the trader or fishmonger wholesale. A model shop at important centres with fixed prices is all that is proposed to be run by Government to stabilise prices with the attendant reforms in hygiene and cleanliness, etc.

Exploitation involves capture, handling, preservation, transport, disposal of waste and manufacture of by-products, all of which it will be the duty of the marketing staff to develop with the assistance of the technical staff of the fisheries organizations. Experience has shown that a great deal can be done for improving the indigenous catching methods. Flooded rivers and deep and perennial tanks go practically unfished as fishermen generally lack efficient craft and tackle. Proper dressing, adequate refrigeration and rapid transport by motors are other new reforms which have already given satisfactory results with reference to three towns in the U.P. Although there may not be any surplus and nearly all fish will be sold fresh, it is possible to utilise fish offal and waste resulting from the dressing of fish for conversion into manure, meal or oil, while the abundant supply of small fish of the Chilwah type at dams as well as Hilsa might afford facilities for canning on a small scale. Model nets and boats, a refrigeration plant and suitable model apparatus for trying out experiments in canning, curing, smoking, extraction of oil and manufacture of manure and meal have to be provided for in the estimate for the Headquarters technological laboratory.

CONCLUSION

In conclusion, all the three sets of operations, conservancy, culture and exploitation need specially trained and thoroughly qualified staff. Such staff is not available and will have to be carefully selected and trained for the purpose. Of the three, conservation and culture are highly technical operations and the staff for these operations need specialised and prolonged training under qualified supervision. It should not be so difficult to recruit competent men for exploitation, though fishery technology from methods of capture to the finished product on the market, needs special training which is available at Madras. If the efforts of the Government of India to provide training at Calcutta or Madras should succeed it should help in the training of fishery officers for the Provinces and States. Thus in the course of a year or two the locally trained men for subordinate posts should be available while the superior posts will have to wait the return of foreign-trained men. During the interval there is no alternative to using such men as are available in India for temporarily filling the posts.

Note.—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India.—*Ed.*

INDIAN SCIENTISTS' DELEGATION ABROAD

IN a message dated Washington, December 11th, *Reuter* announced the arrival in the U.S.A. of the delegation of Indian Scientists after completion of their sojourn in Great Britain. The delegation have thus completed the first part of their itinerary abroad and have before them a eight-week tour of the States under the joint auspices of the Agent-General, the National Research Council and the State Department.

These visits, our readers will remember, were sponsored by the Government of India primarily to enable Indian scientific men to contact their confreres in Great Britain and America and to explore, in a broad and tentative manner, how best such contact and co-operation could be maintained and developed to mutual advantage. The visit to Great Britain is in a way sequel to and a return of the compliment paid by Prof. A. V. Hill who toured India a few months ago. But, it is in no sense a mere courtesy visit having, as it does, certain well-defined objectives. The Indian delegation is headed by Sir S. S. Bhatnagar, the other members being Sir J. C. Ghosh, Prof. M. N. Saha, Prof. S. K. Mitra, Prof. J. N. Mukherjee and Dr. Nazir Ahmed. These names are too well-known, especially to readers of *Current Science*, to need a *Who's who*. A message from London stated that membership of the delegation had been deliberately confined to eminent men of science in India who occupied positions of administrative responsibility.

The activities of the delegation during their stay of about six weeks in Great Britain could only be glanced from the brief messages appearing on and off in the daily press. It makes melancholy reading to learn that even in England, the key press have paid but scant attention to the sayings and doings of the delegates in their midst. Obviously, science is scarcely "Good-copy" for the average newspaper although one must add that war-time conditions are partly responsible for the apparent apathy.

The "high-lights" during what can only

surmise must have been a very crowded programme and which the press recorded were the introduction of the delegates by Sir Henry Dale, President of the Royal Society, to His Majesty who graciously received them; discussions with the members of Parliament interested in Science; several receptions by Government, Civic bodies and academic and learned societies (during one of which, by the way, some historic documents pertaining to the Royal Asiatic Society of Bengal were presented back to the Society through one of the delegates), and a press conference besides many functions of a social nature.

In the absence of fuller details, it would not be fair, even if possible, to comment on the statements and speeches of the members of the delegation cryptic summaries of which have been cabled to this country. It looks as though the members have been individually expressing themselves on subjects which they are specially interested in, rather than the delegation as a body give out its views through one of its members acting as the spokesman of the delegation as a whole—a procedure which is the usual international practice when a body of representative men are on a formal visit outside their own country. The role of science in post-war reconstruction in India, the establishment of a bureau in London to act as a *liaison* body between the two countries in all matters pertaining to or affecting science, recruitment of personnel for Indian research institutions, exchange of students and professors, facilities for training and research for Indian students and technicians in the British Universities and workshops, purchase of scientific instruments and equipment, and, the increasing use of Indian Cotton by the Lancashire Textile Mills, are amongst the diverse topics on which the delegates are reported to have expressed themselves. Even a mere listing of these subjects, by no means exhaustive, is indicative of the many facts of a big problem which the delegation is called upon to handle. And, we have no doubt that the members, every one of whom has close and many-sided contacts with the Indian Scientific World and therefore are in an exceptional position to know of Indian requirements and possibilities, will have voiced the Indian point of view on those subjects with ability and distinction.

Finally, it must not be forgotten that during such visits, the personal contacts made—the reunion of old friends, the formation of new friendships, in short the impact of personalities and ideas—are fruitful of results even more enduring than the formal agreements and conclusions reached. It is for this reason, if for no other, that we must regret that the delegation could not, for want of time, accept the very kind invitation of Ireland to visit that country *en route* to the United States. And, for a full account of these aspects of their visit, we must perforce await the home-coming of the delegation to which we look forward with lively anticipation.

PRESENTATION OF SIR C. R. REDDY NATIONAL PRIZE TO SIR C. V. RAMAN, Kt., F.R.S., N.L.

THE eighteenth Convocation of the Andhra University was held on 18th November 1944 in the Andhra Christian College, Guntur, when His Excellency the Governor of Madras and Chancellor of the University, presided. Two notable events were the award of the Honorary degree of D.Litt. to His Excellency the Hon'ble Sir Arthur Oswald James Hope, G.C.I.E., M.C., and of the Sir Chattamanchi Ramalinga Reddy National Prize in the fist year of its inception to Sir Chandra Sekhara Venkata Raman for eminent merit in Physics. The prize is given each year for eminent merit in either Sciences, or Humanities or Fine Arts by a system of rotation, the cost being met from the interest accruing on the capital sum of a munificent donation given by Sir C. R. Reddy to the Andhra University. Sir Chandra Sekhara Venkata Raman was presented to the Chancellor in suitable terms by Prof. S. Bhagavantam, the University Orator in English. In the course of this oration Prof. Bhagavantam said: "It will take many pages to enumerate the discoveries made by him and the ways in which he has contributed to the advancement of Science. To have discovered new facts is in itself a sign of merit. Sir C. V. Raman has, in addition, discovered a new method of discovery, which is being fruitfully applied all over the world in various fields of research. He has given to Science a new eye with which to explore Nature. Honours have deservedly poured upon him in abundance. The Royal Society of London elected him to its Fellowship in 1924. The British Government conferred a Knighthood in 1929. He received the Nobel Prize for Physics in 1930. Amongst his other Scientific Honours may be mentioned, as specially noteworthy, the Matteuci Medal of Italy, the Hughes Medal of the Royal Society, and the Franklin Medal of America. He has received *Honoris Causa Doctorate* Degrees from nine different Universities. This number, Sir, was eight a month ago. It is now nine and I reliably understand that it will become ten a month hence. It appears to increase more or less at the same rate at which the number of Indian Universities is increasing in recent years. He is an Honorary member of many Learned Societies; and he is the Foundation President of the Indian Academy of Sciences which enjoys a global renown. More than his individual achievements, great as they are, is the glory of having trained a large number of young men, one of whom is an F.R.S., who are making a name for themselves by their creative output and are such inspiring figures in a large number of Universities in India. A Scientist is not a prophet in the astrological sense; I do not know if I am transgressing my bounds by trying to anticipate the verdict of History; but in my humble opinion, Ramanujam and Raman bid fair to be regarded as a Class by themselves and as men who have secured for India a towering place in the Republic of Modern Science."

PLANT NEMATODES, A NEGLECTED SUBJECT IN INDIA

By G. D. BHALERAO, D.Sc. (Lond.)

(*Officer-in-Charge, Veterinary Zoology Section, Imperial Veterinary Research Institute, Izatnagar*)

ALTHOUGH medical and veterinary helminthology has been receiving attention in this country, the field of plant helminthology still remains comparatively unexplored. The only class of helminths known to affect plants are a few genera of nematodes and these the writer proposes to designate as "Phyto-nematodes". Despite its great economic importance it is highly surprising that this branch of science has so far received very meagre attention in this country. The only available reference in India to this subject are those of Butler (1913 and 1919) who described the eel-worm disease of rice and suggested some means of control. Rafay, Padmanabhan and Khanna (1942) have drawn attention to the injury caused by nematodes to sugarcane seedlings and suggested some measures of control. The writer's attention was drawn to this fascinating branch of science when he received, within the past few years, plant nematodes for identification from a few sources in this country. It would, therefore, appear that this is an opportune moment to stress the importance of the study of such worms in this country, of estimating the extent of the ravages they cause to our agricultral produce and finally of evolving an effective plan for their control and eradication. Although so far only three parasites, *viz.*, *Anguillulina tritici* (Steinbuch, 1799), *A. angusta* (Butler, 1913) and *A. similis* (Cobb, 1893) have been recorded from India, this does not, however, preclude the probability of others being discovered in this country. In order to realise the significance of the subject, reference is here made to some important parasites which, barring the three mentioned above, have not yet been recorded from India. In the case of each parasite the names of the economically important plant-hosts and the symptoms produced in them are given. It is not the intention of the writer to deal fully with each parasite within a compass of such a short article, but he will feel his efforts amply rewarded if he could persuade some workers in this country to take up this important line of investigation. Those desirous of obtaining detailed information on the subject would do well to consult Goodey (1933), which will also lead them to other important references on the subject.

1. *Anguillulina tritici* (Steinbuch, 1799).—This small nematode, affecting wheat and barley plants, is known to occur in India. It induces gall-formations in the ears, which are known as "purples" or "cockles". The gall may be simple or compound. The formation of galls within a flower leads to the atrophy of the flower elements. Infected ears are usually shorter than normal ones, and have their glumes standing wider apart.

2. *A. dipsaci* (Kühn, 1858).—This species affects a larger variety of plants than the previous one. Among the important hosts may be mentioned common beet, sunflower, sweet potato, various grasses, oats, barley, sugarcane, wheat, peas, onions, leek, garlic, hemp, banana, tobacco and potato. In dicotyledonous plants, the worms form simple or confluent galls causing deformation of stem and leaf-tissues. Their seedlings generally show a swelling of the hypocotyl. In monocotyledons, swellings are produced at the base of leaves. Affected plants show stunted growth, twisting and rolling of leaves, as well as unthrifty and unhealthy appearance. The parasite may remain in a quiescent state for about six years.

3. *A. angusta* (Butler, 1913).—This species affects rice plants and was recorded in this country by Butler (1913). This worm is entirely ecto-parasitic in habit. In affected plants, leaves wither, the ears are arrested in development and the grains are shrivelled. The glumes usually contain no grain in the lower part of the ear.

4. *A. radicicola* (Greeff, 1872).—This species affects some grasses, oats, barley and wheat. The worms form galls at the tips of roots. The young plants are killed or the leaves and shoots turn yellow, or are stunted and deformed.

5. *A. similis* (Cobb, 1893).—This parasite is known to affect pineapple, canna, coffee, bamboo, sweet potato, banana and sugarcane. It affects roots and has been recorded from India. The affected plants appear unhealthy. They lack in vigour and show sickly discoloured leaves.

6. *A. pratensis* (de Man, 1881).—This parasite affects oats, beet, cabbage, coffee, carrots, bamboo, strawberry, soya bean, cotton, tomato, lucern, poppy, sugarcane, potato, wheat, maize, etc. It affects roots and has been known to occur in India. The affected plants either die or become stunted in growth. The ears remain small and weak.

7. *Tylenchulus semi-penetrans* Cobb, 1913.—This species affects the roots of the orange and grape fruit trees. In heavily infested tracts the plants are stunted and markedly degenerated.

8. *Heterodera schatii Schmidt*, 1871.—The parasite affects pineapple, spinach, sunflower, cauliflower, cabbage, beet, mustard, some grasses, sugarcane, juar, wheet, maize, oats, soya bean, lucern, alfalfa, pea, hemp, poppy, potato, carrot, etc. It affects roots, where its presence gives rise to "giant cell" formation. The leaves change colour, become flaccid and finally die. On account of the excessive development of lateral roots, the main tap root assumes whiskered appearance.

9. *H. Marioni* (Cornu, 1879).—This parasite has a worldwide distribution in tropical, subtropical and temperate regions and affects a very wide range of plants. The chief among these are canna, papaw, sunflower, lettuce, sweet potato, mustard, turnip, radish, water-melon, cucumber, pumpkin, gourd, yam, barley,

sugarcane, wheat, maize, walnut, peanut, gram, soya bean, lucern, alfalfa, pea, tamarind, broad bean, onion, leek, asparagus, yucca, hemp, banana, guava, pepper, almond, cherry, peach, apple, pear, rose, coffee, jasmine, lemon, weeping-willow, red pepper, tobacco, petunia, egg-plant, potato, cocoa, jute, coriander, carrot, grape, turmeric and ginger. The worm forms galls deep in the cortex of the root. Heavily infected plants may be killed outright. In moderately infected cases, the plants are stunted in growth and they readily wilt in dry weather. The leaves die at the edges and there is a protracted death.

10. *Aphelenchoides fragariæ* (Ritzema Bos, 1891).—This affects the strawberry plant and is both ecto- and endo-parasitic. The affected plants are deformed, their leaves become dwarf and the blossoms are also greatly affected. The entire plant becomes red.

11. *A. cocophilus* (Cobb, 1919).—This affects the root and stem of the coconut palm. In affected plants, the leaves become yellowish or brown, nuts are shed in raw condition and there is a shedding of leaves.

---

1. Butler, F. J., "Disease of Rice. I —An Eelworm Disease of Rice. *Bull.* 34. *Agri Res. Inst Pusa*, 1913. India. Butler, F. J , "The rice worm (*Tylenchus angustus*) and its control," *Mem. Dept. Agri India. Bot. Ser.*, 1919, X (1). 2 Goodey, T., "Plant Parasitic Nematodes and the Diseases they cause," London. Methuen & Co. Ltd., 1933, **20.** + 306 pp. 3. Ranay, S. A , Padmanabhan, S. Y. & Khanna, K. L., "Control of Sugarcane seedlings disease and nematode injury," *Proc. Indi. Sci. Congr.*, 1942, **29**, p. 218.

SILVER JUBILEE CELEBRATIONS OF THE PATNA UNIVERSITY

UNDER the inspiring guidance of its Vice-Chancellor, Lt.-Col. Dr. Sachchidanand Sinha, the University of Patna celebrated its Silver Jubilee in the last week of November. During his tenure of office, the University has made remarkable progress; the number of students in the University has been nearly trebled, new colleges, both in arts and science, have been established, and research and higher study has been stimulated by the establishment of a number of fellowships and research scholarships. It was, therefore, in the fitness of things that the Patna University celebrated its Silver Jubilee during the Vice-Chancellorship of Dr. Sinha.

The celebrations commenced with inter-collegiate games and sports. A special Convocation, presided over by H. E. Sir Thomas George Rutherford, the Chancellor, was held on the 30th November, where degrees, *honoris causa*, were conferred on seventeen members distinguished in the realm of law, art, literature and science. The recipients of the degree of Doctor of Law were the Right-Honourable Sir Tej Bahadur Sapru, Sir Maurice Gwyer and Khwaja Sir Mohammad Noor. The degree of Doctor of Science was conferred on Sir M. Visvesvaraya, Sir C. V. Raman, Sir Ziauddin Ahmed, Dr. Birbal Sahni, Dr. A. L. Mudaliar, Dr. H. J. Bhabha, Dr. P. K. Parija, and on Sir S. S. Bhatnagar *in absentia*. The degree of Doctor of Literature was conferred on Sir S. Radhakrishnan, Sir John Sargent, Sir Jadunath Sarkar, Dr. D. N. Sen, Dr. Amarnath Jha and Dr. John Matthai. In addition to these distinguished guests, Patna had the rare privilege of welcoming at their special Convocation the Vice-Chancellors of the Universities of Rangoon and Colombo. The special Convocation was addressed by Sir S. Radhakrishnan. All the members of the Inter-University Board also attended this Convocation.

The Inter-University debates in English, Hindi, and Urdu marked an interesting feature. Sir C. V. Raman acted as one of the judges and gave away the prize for the English Debate which consisted of a beautiful casket in silver containing 25 pillars to mark the Silver Jubilee and having at the top a relief map of Bihar and a miniature of Asoka's pillar and pictures in relief of the temple at Bodh Gaya, the tomb of Sher Shah, the Golghar at Patna, the Wheeler Senate House, and Buddha in a sitting posture. The Trophy was won by the University of Madras. The Trophy for the Hindi Debate was a beautiful miniature of the temple at Bodh Gaya and was won by the Gurukul, Kangri. Both the Trophies are named after the present Vice-Chancellor as the "Sachchidanand Sinha Trophy". Lucknow University won the Ibrahim Hosain Trophy for Urdu Debate.

On the occasion of the special Convocation, H. E. the Chancellor announced the receipt of several generous donations and endowments, notable amongst which were a donation of Rs. 1,00,000 by the Maharajadhiraj of Darbhanga, of Rs. 35,000 by Mr. G. D. Birla, of Rs. 25,000 by Mr. P. C. Tallents, I.C.S. (Retd.), and of Rs. 25,000 by Mr. Gurusaran Lal. In addition to these, Messrs. Tata and Co., Ltd. have donated a sum of Rs. 60,000 towards a chair in Geology, to be called the "Jamshedji Tata Chair". The Government of Bihar have instituted a foreign scholarship to be awarded alternatively in applied chemistry and electrical engineering. Numerous other donations have been received, the total sum up to the present being Rs. 3,11,170.

The celebrations were enlivened by a banquet in honour of the guests, a musical demonstration by the artists of All-India fame, and by a number of lectures and addresses by distinguished speakers.

P. B. GANGULY.

CLASSIFICATION OF PRE-HISTORIC SITES IN INDIA*

By Dr. S. PARAMASIVAN
(*Archæological Chemist, Government Museum, Madras*)

INVESTIGATIONS into Indian prehistory[1] have been comparatively rare, as the subject generally lies outside the scope of an ordinary archæologist, anthropologist or geologist. In addition to training in archæology and its methods, prehistory requires a basic knowledge of geology,[2] ethnology, comparative anatomy, palæontology, zoology, botany, chemistry and the like. It is, therefore, a happy augury that an exploratory branch of the Archæological Survey of India has been constituted with a geologist in it for conducting preliminary survey of prehistoric sites in India.

Bruce Foote,[3] de Terra[4] and others have shown that India is rich in the remains of the earliest phases of the stone age culture. These remains occur in the Kashmir valley, in the alluvia of the upper Indus and in the river basins of the Narbada, the Sabarmati, the Godavery and the Krishna, the Sabarmati, the dant in South India. In addition, there are upper palæolithic, Azilio-Tardenoisean and Capsian industries at Chakradharpur, geometrical microliths of the Tardenoisean variety at Jubbulpur and Magdalenian industry of blades and bone implements with a fauna, some of which have become extinct, in the Billa Surgam caves in Kurnool district.[5] The Campignian stage of culture comes from Banda and Murpha, mid-neolithic phase from Bellary, which merges into the iron age, and shouldered celts and implements and weapons of copper, bronze and iron from Chota Nagpur and Assam.[6] There are also countless megaliths which range from the neolithic to the historical times.

What is the sequence of these cultures? What relation do they bear to similar cultures elsewhere? What part did they play in cultural diffusion? Does the presence of iron in the neolithic sites in Bellary signify that India originated this industry? Or is it a case of zones persisting late in the stone age and passing suddenly into that of iron? Who were the peoples responsible for the megaliths in India and what part did they play? These are some of the problems that face the prehistorian and they are difficult of solution for the present. The difficulty is intensified by the surprising juxtaposition of peoples living in various stages of culture. But in the ultimate analysis, all these problems resolve themselves into questions bearing on classification of prehistoric sites. In fact, classification is the basis of prehistoric work proper.

Scientific classification is based necessarily on scientific excavations. Barring a few notable exceptions, scientific excavations have not been systematically practised in India. As instances of crude excavations by the method of the plough—to quote an eminent archæologist —may be mentioned those at Perumbair in the Chingleput district, Adichanallur in Tinnevelly district and elsewhere. The antiquities unearthed by such methods and exhibited in museum galleries have little or no archæological value, unless correlated with similar finds excavated at the same sites by modern scientific methods. The immediate task is to plan out and conduct excavations scientifically before attempting at final classification of the sites.

Nearly thirty years ago, Bruce Foote published a monumental work on the "Indian Prehistoric and Protohistoric Antiquities", which is considered a *magnum opus* of the Madras Government Museum in prehistory. In the distribution map which is annexed to this volume, the prehistoric sites in India are found concentrated round Madras, in the valley of the river Krishna, in the region enclosed by Raichur, Kurnul, Guntakal and Gadag. There are other concentrations in Gujarat, in Baroda and in the valley of the Sabarmati river. On looking at this map, one feels interested in the conditions that determined such distribution and to know whether they operated simultaneously or in some sequence. But no satisfactory answer is possible at present. In order to study the distribution scientifically, one must have before him a list of all the available prehistoric sites. The sites must be projected on a topographical map. Such a map will then reveal the different combinations of physical and climatic conditions that determined the distribution. It will also reveal some aspects of the personality of prehistoric India. The distribution map will probably enable one to divide the sites into groups and to differentiate the conditions that separate one group from another. Typical sites are taken from each group, scientifically surveyed and excavated. A close study of the prehistoric finds with the characteristic strata associated with them brings out clearly the stages of development of prehistoric civilisations and their contribution to and relation with other known sites. Thus a preliminary listing of prehistoric sites is very important for preparing the topographical distribution map on which alone systematic excavation can be conducted.

There are several lists of sites giving us valuable information: Sewell's List of Antiquities; Coggin Brown's Catalogue of Prehistoric Antiquities in the Indian Museum; Various Government Orders bearing on Prehistoric Sites; List for Coorg; Bruce Foote's Catalogues published by the Madras Government Press; Annual Reports of the Archæological Survey of India; Das Gupta's Bibliography of Indian Antiquities; Information regarding prehistoric sites supplied to museums by various authorities; List for Ramnad district prepared by a Zamin Tahsildar; List of Pudukkotai State; District Gazetteers and personal observations of that brilliant enthusiast, L. A. Cammiade, now in the possession of V. D. Krishnaswami. Some of these lists are not available to the public. They have been consolidated into a

---

* Paper read before the Archæological Society of South India.

comprehensive list by Krishnaswami and it is now with the Archæological Survey of India. But the lists require verification and checking through preliminary surveys. In this preliminary survey, emphasis must be laid on surface indications, the nature of potsherds, the nature of chipped and polished implement, topographical and geological features associated with the finds, the nature of the megaliths and so on.[7] It is needless to emphasise the importance of such surveys for the whole of India including Indian States, preferably under a single authority or in close co-operation with experts engaged in similar work.

For a fuller understanding of the personality of prehistoric India, the distribution maps must be prepared on the results of detailed excavations and classification of excavated sites. There are different aids to this classification and they can be grouped as follows:—

1. *Fossil Study.*—The prehistoric sites are studied in relation to fossil indices associated with them. Organisms are found to undergo progressive changes from one set of geological strata to another. In other words, geological strata can be identified and their sequence established by the fossils enclosed therein. Thus the prehistoric artefacts associated with them are dated. This classification is applied to early palæolithic sites in the Kashmir valley and in the valley of the upper Indus, the Narbada, the Sabarmati and the Godaveri. Fossil finds have not so far been discovered in the lateritic sites of South India.

The earliest cultural strata in India are those of the II Glacial period, which are associated with the earliest flake industry. In this are usually found *Equus, Bubalus, Hippopotamus* and *Elephas namadicus*. But in the Kashmir valley, only a few rolled bones of birds and bovids and *proboscidens* are found.[8] This lack of fossil record is due to the extinction and migration of the fauna on the approach of intense cold due to the II glaciation. Other glacial and interglacial epochs are almost entirely free from fossil remains.

In the lower group of the Narbada valley, *Elephas, Hexaprotodon namadicus* and *Bos* are associated with Abbevillian and Acheulian tools. In the upper group, early palæolithic rolled flakes and cores and late Soan tools are found in association with *Elephas namadicus, Equus namadicus, Hexaprotodon, Bos, Bubalus, Sus, Trionyx*, etc. Stone implements have been found with *Elephas namadicus* and *Bos* in the Godaveri valley. The sites round about Madras are devoid of fossils.

Pleistocene land and fresh water and marine mollusca must be studied as indicators of time, climate and ecological conditions.

2. *River Terraces.*—The prehistoric sites are classified in relation to river terraces, whch are definite geological formations occurring in some sequence. Researches conducted by de Terra, Patterson and Teilhard de Chardin have shown that there is a palæolithic stratification in the alluvia of the upper Indus Valley, which blend with the Himalayan moraines. Thus the glaciated tract coalesces with the non-glaciated region of the plains. The latter contains fossiliferous, and hence dateable, upper Siwalik beds. This classification is useful where the sequence of terrace formations containing artefacts have been worked out with fossil indices or in relation to terminal moraines. For example, in the Siwalik foothills and in the plains of the N.W. Punjab, Poonch and Jammu, there are four terraces, T_1, T_2, T_3 and T_4.[9] Of these T_1 was formed during the II interglacial stage and is associated with Chello-Abbevillian and early Soan cultures. T_2 consists of Potwar loessic silts and the Soan industry of the III glacial period. The third terrace T_3 was formed during the III interglacial stage and is associated with the Soan industry.

On the other hand, the terrace in the Narbada are not so clearly marked and the study of their stratigraphy is possible only through correlation with fossil indices of the northwest Punjab.[10] There are five terraces, namely, T_1, T_2, T_3, T_4 and T_5; T_1-T_2 go with early Soan and T_3-T_4 with late Soan. On the other hand, the terraces of the Courtallaiyar river in the south are clearly marked, but are devoid of fossil horizons. Hence we have to use typical implements as indices to fix the stratigraphy and sequence of the terraces formed during the pluvial and interpluvial periods. These contain implements of the Abbevillian-Acheulian type in the first terrace, Acheulian in the second terrace, late Acheulian and Levalloisian in the third terrace and the Upper Palæolithic in the fourth terrace.[11]

3. *Geochronology*[12].—It is possible to date and classify prehistoric sites by correlating them with geochronology. On the conclusion of the glacial epoch and at the beginning of the mesolithic period, the ice melted and fine mud sediments were deposited in the melt waters. The coarse particles settled down in summer and finer particles in winter. As years rolled on, alternate layers of coarse and fine sediments formed distinct seasonal laminations or varves, all the varves resting one above the other, though not in direct vertical succession. A number of sections at intervals apart are correlated and the complete sequence of sediments, in relation to human artefacts contained therein, established. Baron de Geer has worked out the geochronology of Sweden for 12,000 years. This method is applicable to the Himalayan regions which were subjected to glaciation. It remains to be examined whether the end of the pluvial period has left similar stratigraphy, though the problem of identification may be more complex.

4. *Profiles of Weathering*[13].—The upper portion of a natural, undisturbed deposit in a vertical or nearly vertical section is subjected to weathering. This is brought about by processes which operate through sufficiently long geological time. These processes, which are of a physical or chemical nature, leave their impress. In other words, the profile reflects the climatic, topographical and vegetative environment in which the deposit has existed.

There are several stages of profile development, namely, stages of infancy, youth, maturity and old age. A profile of weathering is in its stage of infancy when it shows only the beginning of the subdivisions of the weathered zone. There are four clearly marked subdivi-

sions from the top down distinguishing the stage of youth, thus:—

(*a*) An eluviated top soil in which most of the coarse-grained arkosic rocks and limestones have been weathered out.

(*b*) An illuviated subzone which is brownish in colour and is compact and plastic and into which clay particles from the top layer have been introduced. From this, limestone pebbles have been dissolved, but the arkosic rocks are still present.

(*c*) Below (*b*) is a yellowish, oxidised zone. It is less compact than (*b*) and is unleached of its calcarious materials.

(*d*) The previous one grading down to unaltered parent material.

A profile of weathering is said to be in a stage of maturity when it is characterised by the following four subdivisions thus:—

(*a*) A top soil resembling the one in the previous case. It may be more siliceous in chemical composition and less fertile.

(*b*) A "gumbo" (very plastic, but compact when wet and hard and jointed when dry) in cases where the topography is flat and poorly drained. If the topography is rolling and well drained, it may contain a silty material with all gradations between for intermediate types of topography. Pebbles are few, small and most resistant. Granites and other arkosic rocks are rare. Limestone is absent and there is some concentration of ferric oxide at the base.

(*c*) Material is leached of the calcareous matter and is oxidised to rusty colour. Otherwise it is but little altered.

(*d*) Material is oxidised to yellowish colour. but unleached of its calcium carbonate.

(*e*) At the bottom there is the unaltered material.

Probably the laterite deposits, as in S. India, represent the profiles of weathering referred to the old age stage.

In the more humid region, the stages of profile development range from infancy to maturity. The silts on the second flats of streams show a profile of weathering characteristic of the stage of infancy. There is a fairly uniform charge of humus matter and there is little or no leaching. The higher levels of streams show a profile of weathering in the stage of early youth. The soil layer is charged with humus matter. It is a compact zone with columnar structure ranging in thickness from 12 to 18 inches. The mature profiles of weathering show a well-developed layer at the top. "gumbo" in the lower, second horizon, with a rusty zone at the base, and caliche and much less weathered, stony silts in the third lower horizon. Petrographic examination shows that the soil has been subjected to prolonged weathering. It is composed of grains of quartz which are rounded and 1 mm. or less in diameter, cemented together with iron hydroxide, amorphous silica grains, large grains of quartz, and a few pellets of iron, alumina and manganese. Similar interesting details are revealed in other layers.

Thus minute and detailed attention should be devoted to profiles of weathering. This aids in the correlation of physiographic levels and in the understanding of the stratigraphy of surficial deposits. It is clear that more work on geology of the surficial deposits along with physiographic levels and profiles of weathering. from one region and climate to another. is of importance. The different physiographic levels can be correlated with the cultural horizons occurring in them.

With reference to the methods enunciated above, much useful information can be gained through co-operation with the Geological Survey of India, who have intimate knowledge of the topography of the country, of the rocks and their weathering characteristics.

5. *Vegetation: (A) Pollen Analysis*[15].—During the post-glacial and post-pluvial times. the development of forests passed through a series of phases. These afford a chronological sequence of great value to geology and archæology. In the glaciated tracts of Europe and America, pollen analyses have been conducted with a view to dating cultural materials. Through this method there is the elucidation of past climates and vegetation as recorded by the stratification of wind-borne spores, preserved in organic, terrestrial sediments. The organic remains themselves may give a picture of the change, but it is of a local nature. On the other hand, a more general record is presented by the pollen grains which are blown from the neighbouring forests and other plant communities. Such micro-fossils are well preserved in peat and similar deposits in cool, humid and glaciated regions. Recently, the principle has been extended to made-up mounds and the associated artificial lake as at Ft Smith, Arkansas in U.S.A. In this country, however, pollen analysis in relation to archæological finds are not even in the exploratory stage.

In this method one must secure typical pollen profiles for a particular region. Any single profile records the varying percentages of pollens found at successive depths and is characteristic of the region concerned. Once these standard regional profiles are available they have several applications. Archæological materials found in different places in the same deposit of peaty material or in different deposits of the same region can be correlated. The pollen analysis reveals the climate and other environmental conditions, which assist in the reconstruction of the cultural conditions associated with artefacts.

In Europe a precise chronology through correlation of varve counts and pollen profiles has been established. It is therefore suggested that to serve the interests of archæology, the following studies must be undertaken in India:—

(*a*) A methodical exploration of suitable peat deposits for cultural remains.

(*b*) A systematic prosecution of pollen studies throughout the country until standard profiles of reference are obtained for each region and the sequence of post-glacial and post-pluvial events is determined.

(c) Correlation of the above events with erosion and sedimentation, both within and without the glacial areas.

Peat deposits occur in the Nilgiris, Travancore, Bengal and Assam.

(B) *Charcoal*[16].—When widely separated sites are compared, there are many sources of error in the results of pollen analysis. Hence, in pollen analysis the geographical position of each site and the peculiarities of its local conditions must be taken into account. In this respect, charcoal found in the sites yields better results. Through identification of sufficient samples of charcoal, the contemporary forest composition is reconstructed in much the same way as through pollen analysis. But the charcoal must be typically representative and must reflect the natural conditions and not be result of selection of man. Such conditions are available in rock shelters and caves as in *Billa Surgam*. Charcoal analysis forms a confirmation of the results of pollen analysis.

The identification of the charcoal is effected by studying the pores, medullary rays, wood fibres, storage parenchyma and the resin ducts in specially prepared specimens.

(C) *Peat Accumulations*[17].—The correlations of varve counts and pollen profiles, and through it, a precise chronology, has been established in Europe. By studying the rate of peat accumulations a rough approximation towards chronology has been developed. This has been made possible by attention to lamination found in peat and also by the study of the depth of objects of known age. The rate is not always continuous, but varies with climate. But oxidised layers cannot be considered. For example, in the Erie basin in the U.S.A., 25 years to the inch in peat older than 30 years has been obtained while in Wyoming mountains, it is 10 years to the inch.

(D) *Humus*[18].—Sears and Couch[18] have worked out humus stratigraphy as a clue to past vegetation of Oklahoma. This has a good future in India for working out archæological strata.

6. *Phosphate Analysis*[19].—Prehistoric sites can be classified in relation to the density of population of the dwelling place sites associated with them. The method depends on the fact that, where the human settlement has been intense, the phosphate content of the soil tends to be higher than in areas which are not habitation sites. The presence of phosphate is due to the presence of bones which have become discarded and decayed. The soil of an area of intensive settlement contains almost fifty times as much phosphate as ordinary soil does. In conducting this investigation, a series of soil samples are taken at equal intervals along a series of straight lines radiating from some central point, preferably the supposed centre of settlement as indicated by antiquities or other features. With these values are constructed contour maps illustrating varying phosphate content and these phosphate contours are then correlated with height contours. Similar diagrams are constructed for the frequency of potsherds. One acts as a check on the other for one and the same place.

7. *Typology*.—The types of implements associated with prehistoric sites serve as a method of classification. For example, eolithic, Chellean, Abbevillian, Acheulian, Micoquian finds are characteristic of the lower palæolithic period. In the middle and upper palæolithic periods, there are the Mousterian, Aurignacian, Solutrean and Magdalenian industries. For the Mesolithic period, there are the Azilian, Tardenoisian and Asturian industries. Sites having the Eolithic, Abbevillio-Acheulian and Soan industries have been found in N. India and in the Narbada valley. In the south, there are the Abbevillian, Acheulian and Micoquian industries. In applying this classification, there is apt to be some confusion between the technological stages and geological sequence as pointed out by Glyn E. Daniel.[20]

Regarding surface finds, it is unlikely that all of them belong to the same period. In such cases one must work out the frequency of the types and classify the site with reference to the largest number of the particular type or types occurring. In fact, Indian types have not been systematically worked out for the whole country.

8. *Pottery*.—Sites can be classified in relation to the information conveyed by prehistoric pottery. The neolithic and megalithic sites yield pottery. And pottery is one of the expressions of art, whether it be most graceful or most clumsy. It expresses the artistic sense of the prehistoric race, their mechanical perception, their sense of utility, adaptability and response to other civilisations. It serves as an index to the growth and development of their civilisation. The pottery can be used in sequence dating as in Egypt and Palestine.[21] Prof. T. Balakrishna Nair has done some pioneering work in this field.

Taking pieces of pottery from suitable sites, those which are decadent in style are classed sparately as late pottery. Others are divided into different classes of dork, with such modifications as are necessary, thus: (1) Black-topped pottery baked partly in ashes, (2) polished pottery, similar but baked in flame, (3) the fancy forms—square, oval, double boats, etc., (4) red pottery with white line designs, (5) black pottery with incised designs, (6) wavy-handled pottery with two ledge handles, (7) decorated pottery with red painted designs. The forms are chiefly classed from the most open such as shallow saucers to the most closed such as bottles. The bowls are classed by the slope of the edge with due regard to the different degrees of incurving. Another criterian is the proportion of the height to the width. A number of sites is examined and the proportion of the different forms is worked out. These proportions reveal the sequence in the development of pottery and hence the basis of sequence dating. If an unknown site is to be defined, its pottery is studied and its position fixed in the series. These aids to classification do not, of course, bar others based on associated finds, their technique, if any, and geological law of superposition.

Thus vlauable field evidences will be destroyed through unscientific excavations. Even salvaging of prehistoric antiquities must be done under control.

In this short resume, the study of prehistory is considered from a range of viewpoints which enable one to get a clear picture of the conditions obtaining on earth in those early stages

of human history. It is difficult for any history to write its own beginnings. But prehistory is an exception. The fossils, the river terraces, geochronology, pollen grains and potsherds have left their indelible records. An understanding of the major problems from the point of view of geology, geography, climatology, palæontology, biology, anthropology, archæology enables one to develop a perspective of value in one's efforts to understand early human history. Thus in classifying the prehistoric sites, each of the methods enumerated above has its own merits and limitations. As many of the aids enumerated here as possible must be applied to a given site and the cumulative evidence critically evaluated. But the methods are complex. Even the geological ones have not been properly worked out in India. There is an urgent need to build up the necessary technique in collaboration with experts working in various branches, in order to be able to reconstruct India's prehistory which, there is reason to believe, will yield a rich harvest of knowledge. At the present time the Archæological Survey of India, under expert guidance of Dr. Mortimer Wheeler, is best fitted for this task.

---

1. The terms "Prehistory" and "Protohistory" have been used somewh t differently by M C. Burkitt (*vide* p 1, *The Old Stone Age* Cambridge University Press, 1933), and by Sir Leonard Woolley (*vide* para 19, *A Report on the Work of the Archaeological Survey of India*, 1939). This must be clarified for India by an agreed terminology. 2. Sir Leonard Woolley, *Loc. cit.*, para 19. 3. *The Foote Collection of Indian Prehistoric and Protohistoric Antiquities*, Madras Government Press, 1916. 4. *Studies on the Ice Age in India and Associated Human Cultures*, Carnegie Institution of Washington, Publication No. 493, 1939. 5. Panchanan Mitra *Prehistoric India*, Calcutta University, 1927, pp. 186–87; 190–91. 6. —, *Loc cit.*, p. 231. 7. Bruce Foote, *Catalogue of Prehistoric Antiquities*, Madras Government Press, 1901, p vi; Sir Leonard Woolley, *Loc. cit.*, para 19. 8. de Terra and Paterson, *Loc. cit.*, p. 226 9. —, *Loc. cit.*, pp. 223–31. 10. —, —, *Loc. cit.*, pp. 313-21. 11. Krishnan, M. S., *Geology of India and Burma*, Madras Law Journal Office, 1943, p. 489. 12. De Geer, Gerard, "Gotiglacial Broad-mapping, Sweden—New York Manitoba", *Report of the 16th Intern. Geol. Congr., Washington, 1899, Washington*, 1936, 1, 192–202. 13. Leighton, M. M., "The significance of profiles of weathering in stratigraphic archæology", *Early Man*. 15. Clark, J. G. D., *The Mesolithic Settlement of Northern Europe*, Cambridge University Press, 1936, pp. 31–44. 16. Cecil Maby, J., "The Identification of Wood and Wood Charcoal Fragments," *Analyst*, 1932, **57**, 2-8. 17. Wright, W. B., *The Quaternary, Ice Age*, Macmillan & Co., London, 1937, pp. 450–51. 18. Sears, Paul B., and Glenn, C. Couch, "Humus stratigraphy as a clue to past vegetation in Oklahoma." *Proc. Okla Acad. Sci*, 1935, 15. 19. Sandell, I, *Strandlinjebestamningar och Markinalys, Fornvannen*, 1932, pp. 40–47. 20. *The Three Ages*, Camb. Univ. Press, 1943.

Note.—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India.—*Ed.*

DEPARTMENT OF CHEMICAL TECHNOLOGY, UNIVERSITY OF BOMBAY

The Annual Report for 1943-44 of the Department of Chemical Technology of the University of Bombay, gives a very pleasing account of the increasingly rapid growth in its activities, aided by a continuous inflow of generous endowments made for furthering the valuable work carried out by the Department. These endowments have been duly announced in our columns from time to time. As a result the Department is or will soon be able to offer degree courses in Oils, Fats and Soaps, and Plastics, Paints and Varnishes (Sir Homi Mehta endowment of Rs. 7 lakhs), a Pharmacy Laboratory with excellent facilities for advanced teaching and research in pharmaceutical chemistry (Topiwala endowment of Rs. 1·25 lakhs), a fully equipped section in Dyestuff Technoloby and Laboratories for advanced research in textile chemistry and modern methods of textile finishing (Bombay Millowners' Association—Rs. 3·92 lakhs).

While it is but natural that admission to this Department for the various courses should be primarily available for the graduates of the Bombay University, it is to be regretted that the admissions are restricted exclusively to them (except for 40 per cent. of the seats in the Intermediates and Dyes Section, financed by the All-India Board of Scientific and Industrial Research). For one has only to just contemplate over the effects of a similar dictum regarding admissions to the Massachusettes Institute of Technology, or the technical departments of the Sheffield University, etc.

The section of the *Report* dealing with research papers published and works in progress indicates that as usual a volume of valuable researches are beieng carried on by the staff and post-graduate students. In addition, the following schemes are in operation under the auspices of the Board of Scientific and Industrial Research: (i) Preparation of Vat Dyes. (ii) Determination of the Constitution of some Commercial Dyes, (iii) Synthetic Dyes and Modified Shades from Cutch, (iv) Preparation of Aniline from Chlorobenzene.

It is interesting to note that the section for analysis and technical investigations handled last year 209 enquiries involving 451 analytical estimations, and a number of investigations of the type, 'Porosity and thickness of electro-tin plates with a view to ascertain their suitability for storing hydrogenated oils', 'analysis and examination of used photographic solutions for recovery of chemicals', etc. It is rather intriguing to read that "the work of the Section has indicated a general tendency towards unskilled adulteration. Thus starches have been very commonly mixed with tamarind flour, udud dal and even clay. Gums have been found mixed with china-clay or starches; sulphur blacks have been liberally mixed with coal-dust; a sample of sodium sulphate was passed off as barium chloride; castor-oil soaps are being sold as vegetable tallow; and numerous cases of a similar character are being repeatedly detected and reported upon".

LETTERS TO THE EDITOR

INFLUENCE OF SODIUM BISULPHITE ON ADRENALINE

IN view of the recent publication of Richards[1] on the influence of sodium bisulphite on the toxicity of adrenaline, we wish at this time to record our experience in this field.

Sjögren and Larsson[2] first noticed that sodium metabisulphite stabilised adrenaline solution. In the 4th *Addendum* to B.P. (1932) incorporation of the above salt to an injection of procaine and adrenaline has also been advocated (*cf.* Woolfe[3]). It is being noticed by us that this salt protects the above solution and even liquor adrenaline hydrochloride from a sort of oxidation that is partly responsible for the development of a pink colour in the solution. But the bisulphite salt of alkali metal invariably increases the toxicity of the solution.[4]

The direct influence of sodium bisulphite on adrenaline was shown by dissolving pure adrenaline base (0·1 gm.) in water (100 c.c.) containing molar amount of sodium bisulphite, and the pH was adjusted to ca 6·5 with sulphur dioxide in one case and to 2·8 in another. The solutions were heated at 80° C. for 100 hours in an atmosphere of carbon dioxide. No change in colour was noticed in any solution but the potency on biological assay on decapitated cat was found to be practically nil in the former and only 45 per cent. in the latter. Control experiments were also done by preparing solutions of pure l-adrenaline base (0·1 gm.) in water (100 c.c.) saturated with carbon dioxide without any addition of sodium metabisulphite and sulphur dioxide. The pH of one solution was adjusted at 6·5 by passing more of CO_2 gas in the cold and at 2·8 in another with a trace of hydrochloric acid gas. On heating the solutions at 80° C. for 100 hours in an atmosphere of carbon dioxide both the solutions became somewhat coloured but the potency on biological assay was found to be 42·2 per cent. in the case of the former and 65·5 per cent. in the case of the latter.'[4] These show that the bisulphite has a direct destructive action on the physiological activity of adrenaline. As such it is a question whether any parenteral solution containing adrenaline should be mixed up with any alkali metal salt of sulphurous acid. Details of the work are being published elsewhere.

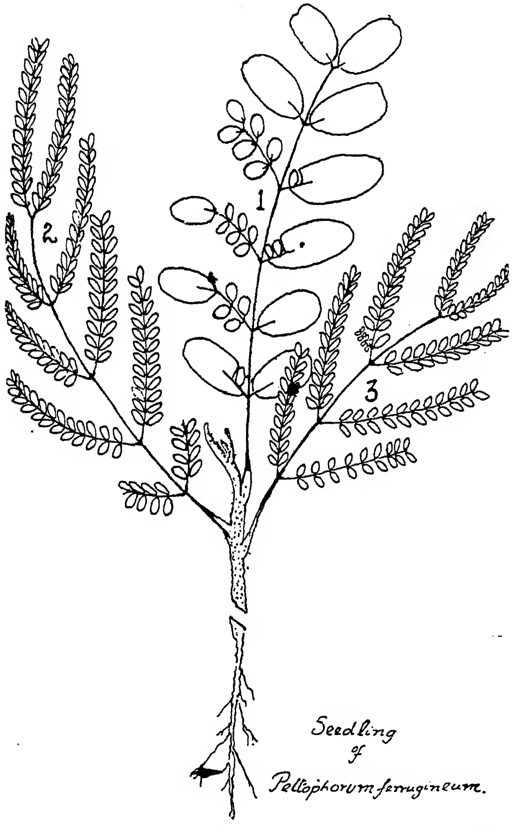
Bengal Immunity Research Laboratory, Calcutta, S. K. GANGULI.
August 7, 1944.

1. *J. Pharmacol.*, 1943, **79**, 111. 2. *Farm. Revy*, 1936, **35**, 309. 3. *Quart. J. Pharm. Pharmacol.*, 1941, **14**, 234. 4. Bose, A. N., *Private communication.*

COMPOUND—BI-COMPOUND LEAF TRANSITION IN *PELTOPHORUM FERRUGINEUM* BENTH.

Peltophorum ferrugineum Benth. is a common ornamental avenue tree said to be indigenous to Ceylon and Malaya (Macmillan[1]). Its leaves are generally bicompound, the number of secondary rachises varying from four to six; the number of pinnæ per secondary rachis is about ten to twelve pairs. It was observed almost as a feature of common occurrence that on the adult tree there were a few leaves which were pinnately compound instead of bipinnately compound. The number of leaflets was approximately equal to the number of secondary rachises in the bipinnate leaves. A number

of seedlings were raised for critical observation and they exhibited almost all the stages of transformation from a single leaflet into a collection of pinnæ. Figure shows a seedling in which all the stages are represented. In leaf 1, there are 6 pairs of leaflets pinnately arranged. Leaf 2 is a normal bicompound leaf with five secondary rachises. In leaf 1, we see all the stages of the division of the leaflet into smaller segments—the pinnæ. In other words, we could see the derivation of the bicompound leaf from a pinnately compound leaf. It is generally admitted that phylogenetically the compound leaf is derived by the segmentation of a simple leaf-lamina and the subdivision of the leaflets leads to the formation of the pinnæ of the bicompound type. Troll[2] has discussed the possibility of such a derivation. His figures show clearly all the stages that have been noticed in *Peltophorum ferrugineum*.



It is interesting that in the juvenile condition there is almost a recapitulation of the phylogeny of the bipinnate leaf. Just as in the case of some Australian Acacias there is a recapitulation of all the stages leading to the ultimate formation of the phyllode, even so in *Peltophorum* we find all the stages leading to the formation of bipinnate leaves recalled in the juvenile condition. A number of seedlings were examined and almost without exception this transition from pinnate to bipinnate condition was seen. This tendency to subdivision was also found to be extended to the pinnæ themselves, though rarely. In leaf 3, we find one of the pinnæ already subdivided into smaller segments. No case of complete segmentation of all the pinnæ leading to the tripinnate condition was, however, met with. But a tendency towards that is unmistakably exhibited.

The seedlings of *Peltophorum ferrugineum* can well be employed for purposes of visual demonstration of the evolution of the bipinnate condition from a pinnate leaf.

I wish to express my indebtedness to Prof. T. S. Raghavan for having drawn my attention to this and for suggesting relevant literature.

Department of Botany,
Annamalai University,
Annamalainagar, K. V. KRISHNAMURTHY.
August 17, 1944.

1. Macmillan, H. F., *Tropical Planting and Gardening*, 1935. 2. Troll, Wilhelm, "Vergleichende Morphologie der höheren Pflanzen," *Erster Band: Vegetationsorgane*, 1939, page 1463, *Abb.* 1212.

POTATO 'TOPS' AND 'EYES' AS SEED

THE potato is an important food crop. Also it can provide raw material for the manufacture of starch, alcohol and synthetic rubber. During this war, therefore, attempts have been made to increase its area, especially in the U.S.S.R. As the seed supply was found to be the limiting factor in the expansion of the area under potato cultivation, Professor Lysenko and his co-workers[1] proposed to utilize as seed a small piece from the rose end of the tuber containing one or more eyes and to use the rest of the tuber (representing about 90 per cent. of the whole) for food. It is reported that the 'tops' yielded as well as the whole tubers and that their produce was less subject to disease. The idea was carried still further by Professor Yakushkin (quoted by Garner[2]) who devised a method of 'tuberless' sowing of potatoes. The seed in this case is the eye itself with a small piece of flesh attached. Copisarow[3] reported certain experiments on 'tops' and peelings which seem to have given satisfactory results. Evans[4] studied this problem from the point of view of the possibility of transporting by air potato 'tops' for seed purposes to certain British overseas dependencies. His preliminary experiments indicate that 'tops' give a satisfactory yield. It would, thus, appear that small piece of the tuber might suitably be substituted for the whole tuber as a wartime measure. An experiment was, therefore, conducted during 1943–44 at the Imperial Agricultural Research Institute, New Delhi, with a view to finding out the possibility of utilizing potato 'tops' and peelings as seed under the conditions of the plains of North India. The results are reported herein.

Whole tubers, halves and 'tops' of *Phulwa* and *Gola* varieties which are generally cultivated in the plains of North India, were planted directly in the field on November 5, 1943. Farmyard manure at the rate of eight cartloads per acre was added to the plot just before planting. The tubers or tuber pieces were planted in rows 2 feet apart and were spaced at a distance of 1 foot in the row. The average weight of the *Phulwa* tuber used in this experiment was 21·45 gms., that of the

half tuber was 10·72 gms., while the 'top' weighed 4·2 gms. The weights of *Gola* were 33·57 gms., 16·78 gms., and 6·4 gms., respectively. Thus the 'tops' were one-fifth size of the whole tuber. If bigger tubers are used, the size of the 'tops' would remain the same as the one used in this experiment. The 'tops' germinated along with the whole tubers and the halves and in the early growth period the young plants of all the three lots were equally vigorous. During the growing period observations on height and number of leaves were taken. The plants were harvested on March 23, 1944, and their yields were recorded. These observations are summarised in Table I.

Tubers harvested from plants from whole tubers, halves and 'tops' were of the same size in the case of *Phulwa*. In *Gola*, on the other hand, tubers from 'tops' were slightly smaller than those from whole and half tubers.

From Table I it would appear that (*i*) percentage of germination of 'tops' was as high as that of whole and half tubers; (*ii*) plants from 'tops' did not have the same luxurious vegetative growth as the plants from whole and half tubers; (*iii*) the 'tops' yielded less than whole and half tubers. *Phulwa* seems to be a more suitable variety than *Gola* for planting 'tops' as seed.

Peelings or skins of *Phulwa* and *Gola* each containing an eye, were first planted 6 inches apart in boxes on November 2, 1943. Seedlings were then planted in the field on December 22, 1943. They had a spacing of 1½ feet between them and 2½ feet between rows. Farmyard manure was added to the boxes and to the field before planting. Few plants did not survive after transplanting and few others were damaged by porcupines. Observations on germination, growth and yield were taken and are summarised in Table II. Although whole tubers were not planted in the boxes along with the 'eyes', the yield of plants from whole tubers planted in the field nearly at the same time were recorded for comparison.

The size of the tubers harvested from plants raised from 'eyes' both in *Phulwa* and *Gola* was small. It will be clear from Table II that 'eyes' gave rise to plants poor in growth and also poor in yield.

Although poor yields were obtained from plants raised from 'eyes', the yields of those from 'tops', at least in the case of the *Phulwa* variety, were not very unsatisfactory as compared with those of plants from normal seed. It might be possible to compensate for the decreased yield per plant by adopting a closer spacing, and by suitable manuring, and experi-

TABLE I

Observations on germination, growth and yield of plants from whole tubers, halves and 'tops' of Phulwa *and* Gola

Variety	Kind of seed used	No. of sets planted on 5-11-43	No. of plants germinated	Average height in cms. on 17-12-43	Average height in cms. on 19-2-44	Average No. leaves per plant on 17-12-43	No. of plants harvested on 23-3-44	Actual yield	Yield per 100 plants
								lbs. oz.	lbs. oz.
Phulwa	Whole	108	107	11·1	18·0	31·9	100	51 8	51 8
	Half	108	106	11·7	17·2	33·4	94	42 8	45 3
	'Tops'	108	103	7·3	12·3	20·2	93	32 12	33 6
Gola	Whole	108	103	6·2	10·6	18·3	94	26 0	27 11
	Half	108	106	7·0	10·2	21·0	99	27 8	27 12
	'Tops'	108	104	4·2	6·9	8·4	101	10 8	10 6

TABLE II

Observations on germination, growth and yield of plants from potato peelings

Variety	Kind of seed used	No. of peelings sown in boxes	No. of plants germinated	No. of plants transplanted on 22-12-43	Average height in cms. on 21-12-43	Average height in cm. on 22-2-44	Average No. of leaves on 21-12-43	Average No. of leaves on 22-2-44	No. of plants harvested on 18-4-44	Actual yield	Yield per 100 plants
										lbs. oz.	lbs. oz.
Phulwa	'Eyes'	55	29	28	2·5	3·3	6·0	8·7	15	2 13	18 12
	Whole tubers	Planted directly in the field							15	7 11	51 4
Gola	'Eyes'	51	37	35	2·0	2·6	4·4	7·0	9	0 11	7 10
	Whole tubers	Planted directly in the field							9	2 7	27 1

ments have been laid down to investigate these possibilities. Experiments are also in progress to find out whether 'tops' from dormant or non-dormant tubers would be more suitable as seed, and also to determine the relative value of 'tops' cut from the apical end and those taken from the basal end of the tuber. Experiments to determine how long 'tops' and 'eyes' can be kept in a viable condition are also in progress.

Imperial Agricultural Research
Institute, New Delhi, B. P. Pal.
October 7, 1944. M. J. Deshmukh.

1. Anon, "Soviet scientific work on potatoes", *Nature*, 1942, **150**, 453-57. 2. Garner, H. V., "Intensified potato culture in the U.S.S.R.", *J. Min. Agric.*, 1943, **50**, 20-21. 3 Copi arow, M., 'Potatoes and war economy', *Nature*, 1943, **151**, 421-22. 4. Evans, G., "Potato eyes as readily transportable 'seed' for the colonies", *Ibid.*, **1943**, **152**, 464-66.

TONIC ELONGATION OF UNSTRIATED MUSCLE

Plain muscle is known to contract on the application of stimuli, but an active elongation has not been hitherto described. Plain muscle is elongated by the application of external extending force, but whether it can do so without the application of such a force is a doubtful point.

The following experiments suggest that elongation may be active. If pieces of the muscle of frog stomach cut transversely, be placed in distilled water, after an initial contraction, it entirely loses all tone and becomes flaccid. It does not however die, at least for two hours, as shown by irratability to electric current or potassium when replaced in normal saline. If the muscle is placed free in a trough, to which distilled water is added, it lengthens without the application of an extending force (Table I). The length was measured by means of a divider and sometimes the muscle had to be very lightly pressed to flatten out any curvature. Elongation occurs at a much slower rate in a moribund muscle; it is difficult to be sure whether such muscles are dead or alive. It appears that normal excitability is necessary not only for contraction but also for elongation.

In 60-75 minutes, a good muscle may elongate to its maximum extent, by almost 100 per cent.; a moribund muscle may take hours. It increases in weight by about 60-70 per cent. The increase in length is due either to the general increase in volume or to active elongation. It does not appear to be due to the former cause as (*a*) the lengthening is rather too great if the muscle should swell in all dimensions, (*b*) there is no correlation between the swelling and the elongation, (*c*) *Mytilus* muscle may swell enormously in 0·564 M. sodium cyanide and yet shorten, (*d*) a control striated muscle elongates to a very slight extent, (*e*) in 0·154 M. potassium chloride, the muscle swells but does not elongate.

The elongation appears to be active comparable to contraction, and is probably due to dilution of the ions in the muscle. It appears that tone is due to combination of ions with the muscle proteins. It could not be due to ions in the saline, as placing the muscle in a sucrose solution causes tonic contraction.

If plain muscle is a purely viscous body, then such an elongation is only possible by means of an external extending force. If the process of contraction is due to some colloidal change attended with changes in viscosity then the return to the original length can only occur by external tension, if the muscle is a pure viscous body. If the contraction is due to some electrostatic attraction, such as between parts of a folding myosin molecule, then lengthening can occur if there is an electrostatic repulsion between adjacent folds, and the molecule will unfold like the leaves of an electroscope. A thrusting tension can only be produced, however, if the muscle is prevented from buckling. The use of a tonic elongation would be to hasten relaxation against internal viscous resistance.

Table I (*a*)

Increase in length

Time in hours	Solution	Length in m m. of frog stomach	Length of frog rectus
0	Saline	18·3	22·2
¼	H_2O	25·0	23·0
½	H_2O	28·2	21·8
¾	H_2O	30·9	21·2
1	H_2O	32·6	21·0
1¼	H_2O	33	20·0
1½	H_2O	33	20·0
1¾	H_2O	33	
1¾	KCl	33	
2	KCl	18·6	
2¼	KCl	17·0	
2½	KCl	16·8	
3	KCl	15	
4	KCl	15	
24	KCl	15	
25	H_2O	15	
26	H_2O	16	
27	H_2O	16	
36	H_2O	20	
48	H_2O	30	

Table I (*b*)

Increase in weight of frog stomach

Time in hours	In H_2O	In 0·154M KCl
0	0·0 p.c.	0·0 p.c.
1¼	67 ,,	7 ,,
2½	100 ,,	3 ,,
3¼	140 ,,	15 ,,
7¼	180 ,,	20 ,,
24	185 ,,	40 ,,

Department of Physiology,
Medical College,
Hyderabad, Sind, Inderjit Singh.
October 17, 1944.

THE MAGNETIC STUDY OF QUINHYDRONE

THE structure of quinhydrone has been the subject of extensive investigations. Majority of the experimental evidence is against the view advocated by Willstätter and Piccard that the hydroxyl groups of the benzenoid component of quinhydrone is linked co-ordinately to the carbonyl oxygen of the quinonoid component. Pfeiffer[2] regards quinhydrone as an additive compound with its components held together by residual valencies of the nuclei. Another view of more recent origin is that in the compound the two components are held together due to the interaction between the strongly polar quinonoid groups and the anisotropic, polarisable quinol nucleus. This view is supported by X-Ray analysis of crystals of quinhydrone in which discrete existence of quinonoid and quinoloid units has been shown.[3] A mechanism of how the union is affected is obvious on the above view. The polar quinonoid groups induce corresponding moments in the quinol nucleus and the union is thus affected by the electrostatic interaction between the permanent and induced moments. A similar view has been put forward in case of molecular compounds of sym. Trinitrobenzene.[4] The 'London' Forces thus involved are intermediate between van der Waals's forces and true covalencies. Such weak electrostatic interactions between the two components as in the case of quinhydrone should not effect the magnetic susceptibilities of the two components largely and it should be expected that the molecular magnetic susceptibility of quinhydrone should not differ very much from the sum of the molecular magnetic susceptibilities of quinone and quinol. This should particularly be true in case of quinhydrone since both the components are symmetrical with respect to the substituent groups.

The magnetic susceptibilities of quinone, quinol and quinhydrone were determined by Palacios and Froz.[5] and their results showed that molecular magnetic susceptibility (χ_m) of quinhydrone differs considerably from the sum of the molecular susceptibilities of quinone and quinol. We have, therefore, undertaken the determinations of carefully purified samples and the results are tabulated in Table I. The determinations were made on a modified form of Guoy's Balance. The working of the apparatus was checked by determining χ (mass susceptibility) of a number of substances whose values are known very accurately, *e.g.*, potassium chloride, sodium chloride, benzene, alcohol, etc. Water was taken as reference substance with $\chi = -0{\cdot}720 \times 10^{-6}$. The results were correct within 0·7 per cent. of the accepted values.

TABLE I

Substance	M.P.	Molecular weight	$\chi \times 10^6$ Mean of 3 concordant readings	$\chi_m \times 10^6$	$\chi_m 10^6$ Reported by Froz and Palacios
1. *p*-Benzoquinone	117°	108	0·333	35·96	33·3
2. Hydroquinone (Quinol)	171°	110	0·601	66·11	64·58
3. Quinhydrone	171°	218	0·468	102·05	84·2

The sum of the molecular susceptibilities of quinone and quinol is thus $-102{\cdot}07 \times 10^{-6}$ which is nearly equal to χ_m for quinhydrone ($= -102{\cdot}05 \times 10^{-6}$).

The results support the view about the structure of quinhydrone that the two components are held together in the compound by weak electrostatic forces.

However, it should be clear that this agreement between the sum of χ_m of components and χ_m of the molecular compound may be true in this case only, while, in other similar cases, where the resultant compound may be more or less symmetrical, the diamagnetic susceptibility of the compound may be greater or lesser than the sum of the components.

The results on other similar molecular compounds of *p*-quinone and symmetrical Trinitrobenzene will be published shortly.

Department of Chemistry,
Government College,
Lahore,
November 4, 1944.

SUNDER LAL.
NOOR-UL-HAQ KHAN.

1. Willstätter and Piccard, *Ber.*, 1908, **41**, 1458; A, 1908, **i**, 475. 2. Pfeiffer, P., and collaborators, *Annalen*, 1924, **444**, 241–64, 1914, **404**, 1-20. 3. Stuart Anderson, *Nature* 1940 **140**, 583–84. 4. Fevre, R. W. L., *Trans. Farady Soc.*, 1937, **33**, 210 5. Palacios, J., and Froz, O. R., *Anal. Fis. Quim.*, 1935, **33**, 627–42.

A NOTE ON *HELIOTHIS ARMIGERA* HUBN., AS A PEST OF PEA (*Pisum sativum*)

Heliothis armigera Hubn. (*Chloridea obsoleta F.*) is well known as a pest of various crops. It occurs in America as a cotton ballworm. Fletcher (1914) describes it as a pest of red-gram, Bengal-gram, groundnut, maize (cob), tobacco (seed capsules), ganga (leaves and capsules), safflower (capsules), etc. The writer finds it in Calcutta as a borer of pea-pods, destroying the cotyledons. The only other record of its infestation of pea-pods was from Lyallpur. So far, however, its life-history in pea has not been reported.

This pest was collected from pea-pods obtained from local markets and was reared in the laboratory. The larvæ collected from pea-pods were kept separately in separate glass-vials plugged with cotton, so as to note their individual growth and period of pupation. They were fed with pea-pods. The larvæ were voracious eaters and occurred in great abundance during the months of January and February 1944. Their number decreased from March onwards. The maximum length of a full-fed larva reared in the laboratory was 3·6 cm. They were bright-green in colour,

which showed considerable variation. The larvæ pupated within the vials during the months of February and March. No cocoon was formed, but the pupæ were found to be held by some fine thread-like structures, probably formed by the secretions of the silk-gland. The pupæ were dark-brown in colour and their lengths varied from 1·6 to 1·9 cm. The duration of pupal period varied from 8 to 12 days.

In course of rearing this pest the writer also came across the following species as infecting pods:—(1) *Polyommatus boeticus* L., during the months of December, January and February and (2) *Etiella zinckenella* Tr., during the months of February and March. The last mentioned species is regarded as a minor pest of pulses by Fletcher (1914), but since it occurred in sufficient number, it may be regarded as a major pest like *Heliothis armigera* H., the incidence of the two pests taking place in different periods of the pea-season.

Department of Zoology,
University College of Science,
35, Ballygunge Circular Road,
Calcutta, PRABHAS KUMAR MITRA.
November 4, 1944.

1. Ayyar, R., *A Handbook of Economic Entomolgy*, 1940. 2. Fletcher, T., *Some South Indian Insects*, 1914. 3. Hampson, G., *Fauna of British India*, 1894, Moths 2. 4. *Rept. Proc. 3rd. Ent. Meeting, Pusa*, 1919, 1, 60.

THE THERMAL DECOMPOSITION OF MERCURIC FULMINATE

HOITSEMA[1] obtained a yellowish product on heating mercuric fulminate to 132° C. which could be heated to higher temperatures without explosive decomposition. He believed that this residue was mercuric oxide and, strangely enough, he found in the gaseous products of decomposition no cyanogen, no carbon dioxide and no carbon monoxide but only oxygen in an almost pure state. Hess and Dietl[2] found that when 0·5 gm. of fulminate was heated in a test tube at 90-95° C. for 75½ to 97 hours it was transformed into a brownish yellow, non-explosive, difficultly combustible isomerisation or polymerisation product with no change in crystal structure. Langhans,[3] working with 15 gm. of fulminate heated in a cylindrical Passburg vacuum drier maintained at 90° C. for 100 hours, obtained the brownish yellow transformation product with similar characteristics, made an exhaustive qualitative study of its chemical properties and named it "Pyrofulmin". Although he never got consistent results on analysing the solid residues obtained from several runs, he concluded from his analytical figures that carbon and oxygen alone disappeared partly and, from his highest values, he worked out the empirical formula of the compound as $Hg_4N_7C_5O_5$. If this formula were correct it is evident that there would have to be some nitrogen in the evolved gases.

Farmer[4] was the first to study quantitatively the velocity of decomposition of mercuric fulminate *in vacuo* at temperatures between 60° and 90° C. using 1 to 2 gm. of the substance. He found that the velocity curves are of an abnormal type with an initial quiescent period, decomposition setting in somewhat abruptly, proceeding at first with a nearly constant velocity, which increases slightly until the decomposition ultimately ceases almost abruptly. The main relevant conclusions from his experiments are:—

(i) The temperature coefficient within the temperature interval is 1·12 per degree centigrade or 1·75 per 5° C., a fact of fundamental importance in the drying and storage of this explosive and its mixtures.
(ii) The total quantity of evolved gas at 80° C. per gram varies from 44·3 to 48·5 c.c. which corresponds in the mean with 0·58 mol. per mol. of fulminate.
(iii) The evolution of gas is proportional to the quantity of fulminate.
(iv) The gas evolved is nearly pure carbon dioxide although on prolonged heating gases unabsorbed by soda lime were given off.
(v) The residue from the decomposition believed to be a solid autocatalyst is a brown, insoluble material, particles of which retained their original shape.

Garner and Hailes[5] using a more elaborate and refined technique and working with single crystals, 1 to 5 mgms. in weight, followed the decomposition and detonation *in vacuo* in the temperature range 100° to 120° C. They found that *in vacuo* the thermal decomposition passes into detonation at 105° to 115°C. and that below the ignition temperature the decomposition occurs in three stages:—

(i) A quiescent period;
(ii) a period of acceleration of rate of reaction for which the logarithmic relationship, $\log (dp/dt - dp_0/dt) = kt +$ constant holds; and
(iii) a region where the first order equation applies.

Stages (ii) and (iii) occur in crushed and ground fulminate also. The critical increment of the thermal reaction is approximately 30 kg. cal. and the volume of the total gas evolved in c.c./gm. lies between 52 and 55 c.c.

The writer has studied the decomposition of several batches of mercuric fulminate of purity $99 \cdot 3 \pm 0 \cdot 2$ per cent. at 100° and 120° C. using 0·1 gm. of the material in the apparatus developed and standardised by Farmer (*loc. cit.*) for the examination of the vacuum stability of certain types of high explosives. A preliminary critical examination with four stability tubes at 100° C. with 0·1 gm. of the explosive in each from a small portion of the same batch has revealed that:—

(i) apart from small variations in the individual rates, especially in the early stages, owing probably to differences in total effective surface, the general course of the decomposition is substantially the same in all;
(ii) the decomposition is nearly complete in about 32 hours but, thereafter a slow but continuous evolution of small quantities of gas takes place for a

further period of 64 hours after which no more gas is evolved over a period of 48 hours;

(iii) no further gas evolution is noticeable by keeping these tubes at temperatures 120–125° C. for periods up to 120 hours;

(iv) the total volume of gas evolved is $5 \cdot 21 \pm 0 \cdot 04$ c.c. at N.T.P. which works out to 2 molecules of gas for every three molecules of fulminate.

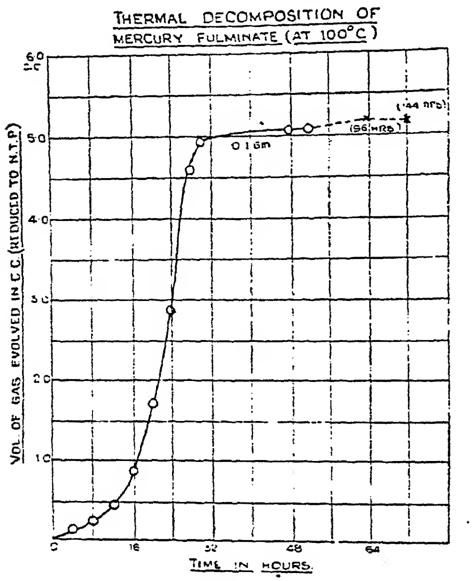


FIG. 1

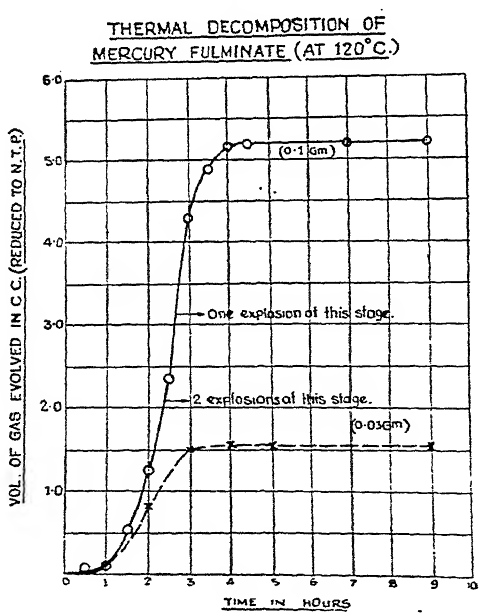


FIG. 2

A systematic error of approximately $-0 \cdot 04$ c.c. attributable, under the conditions of experiment, to thermal expansion of the heating tube has been located and all the values of final gas volumes reported here are automatically corrected for this by taking the pressure measurements after cooling the system to laboratory temperature. Figures 1 and 2 show the average results of the preliminary runs at 100° and 120° C. The curves are substantially similar to those obtained by Farmer and by Garner except for the final stages and for the practical absence of the initial quiescent period. The probability of explosion is nil with $0 \cdot 1$ gm. at 100° C. and $0 \cdot 03$ gm. at 120° C. while it appears to be 3 in 4 at the higher temperatures with $0 \cdot 1$ gm. of the material and seems to centre round the time of half decomposition. The temperature coefficient and the critical increment of the time of half change are $1 \cdot 75$ per 5° C. and approximately 32 Kg. cals. respectively which are in substantial agreement with the results of previous workers. A number of other batches examined behaved in the same way, yielding the same quantity of gas within the range of experimental accuracy.

Analysis of the gas carried out with the Ambler[6] portable type of apparatus on samples taken at the final stage showed that it consists entirely of carbon dioxide and carbon monoxide in the ratio of 3 : 1. This was further

FIG. 3

confirmed in a special run by a proportionate pressure fall in the manometric limb of the apparatus under test which contained a short length of saturated caustic potash solution on the top of the mercury column, while a blank, empty tube, similarly got up, allowed for extraneous factors.

The solid residue retained the original crystalline shape and consisted of brown shining crystals (Fig. 3). On analysis this substance has been invariably found to contain $77 \cdot 57 \mp 0 \cdot 2$ per cent. mercury using the method described by Treadwell[7] after dissolving it in

warm moderately strong sulphuric acid and cautiously diluting it just before precipitating the sulphide. A complete elementary analysis has not been attempted as yet owing partly to the difficultly combustible nature of the substance but chiefly to the relatively little information that is likely to accrue from it. A molecular weight determination by the usual methods appears to be out of the question because of the insolubility of the substance in water and all the organic solvents tried. It is, however, hoped to continue the work, as soon as peace is declared, with a view to determining directly the heat of combustion of the substance in a calorimetric bomb and to studying also its crystal structure. The result so far obtained indicate that the substance is definitely homogeneous and that it is most probably a single chemical compound stable at least up to 125° C. with the empirical formula $Hg_6O_5C_8N_{12}$, obtained presumably by 3 molecules of fulminate polymerising in a manner characteristic of cyanogen compounds and at least two such polymers decomposing together giving rise to the products below:—

$$3\ Hg(ONC)_2 \longrightarrow \underset{\text{hypothetical \& unstable}}{Hg_3(O_2N_2C_2)_3}$$

$$2\ Hg_2(O_2N_2C_2)_3 \longrightarrow \underset{\text{Brown residue}}{Hg_6O_5C_8N_{12}} + 3CO_2 + CO$$

The compound formulated would have a mercury content of 77·77 per cent. which is in fair agreement with the value experimentally obtained. It is proposed to name this substance mercuric pyrofulminate or shortly "pyrofulmin", after Langhans. It would appear that this compound would open out a new type of morphological relationship, which for want of a better word may be described as pseudo-polymeric-isomorphism. It is considered that any further theorising regarding the molecular nature of the compound should await the results of the work contemplated.

The author wishes to place on record his gratitude to Mr. M. D. Owen, the Assistant Inspector, and to Dr. H. R. Ambler, F.R.I.C., the Chief Inspector of Military Explosives, for much valuable criticism, encouragement and grant of permission and facilities to do the work and to the Director of Armaments, India, for grant of permission for publication.

Inspectorate of Military Explosives, Kirkee,
November 7, 1944.

P. Y. NARAYANA.

1. Hoitsema, Z., *Physikal. Chem.*, 1896, **21**, 137. 2. Hess and Dietl, Muspratt's, 'Enzyklopädischem Handbuch der technischem Chemie," 1900, **7**, 968. 3 Langhans, *Z. ges. Schiess—u. Sprengstoffw.*, 1922, **17**, 9, etc. 4. Farmer, R. C., *J. Chem. Soc*, 1922 **121**, 174, *Ibid.*, 1920, **117**, 1432, 1603. 5. Garner, W. E., and Hailes, H. R., *Proc. Roy. Soc.*, 1933, A, **139**, 576. 6 Ambler, H. R., *J. Sci. Instr.*, 1931, **8**, 369 see also Lunge and Ambler, "Technical Gas Analysis," 1934, 81. 7. Treadwell, F. P., and Hall, W. T., "Analytical Chemistry." Vol. II, 6th Edn., 1924, 172.

Note.—The approximate density of the decomposition product has been determined in carbon tetrachloride and in diamylphthalate at 28° C. and found to be **5·1**. Mercuric fulminate, under similar conditions, has given a value of **4·4**.

CANTHARIDIN CONTENT OF *MYLABRIS MACILENTA* BEETLES

In the search for a suitable substitute for 'Cantharis Pulvis', an item occurring in the Priced Vocabulary of the Government Medical Store Depots in India, and in fair demand for the preparation of a number of medicinal preparations, the Director (Drugs & Dressings), Directorate-General of Supply (Medical Division), New Delhi, sent to the Biochemical Standardisation Laboratory, Calcutta, a specimen containing blister beetles for analysis and opinion.

The analytical data according to the B.P.C. (1934) method were found to be as follows:—

Analytical Data:

(1) Loss on drying at 100° C.—15 per cent. (B.P.C. Mylabris—volatile matter at 100° C. about 13·5 per cent., U.S.P. XI and B.P.C. Cantharis—not more than 10 per cent.).

(2) Ash—6·1 per cent. (B.P.C. Mylabris—about 6·5 per cent.; B.P.C. Cantharis—about 8 per cent.).

(3) Fat—13·1 per cent. (B.P.C. Mylabris—present; B.P.C. Cantharis—about 12 per cent.).

(4) Cantharidin—1·3 per cent. B.P.C. Cantharis—not less than 0·6 per cent.; commercial varieties—0·4 to 0·8 per cent.; B.P.C. Mylabris—1 to 2·3 per cent.; U.S.P. XI Cantharidin—not less than 0·6 per cent.).

It was concluded that the cantharidin content of the sample of beetles satisfied the standard as specified by B.P.C. or U.S.P. for cantharidis (*Cantharis vesicatoria*) or B.P.C. Mylabris (Synonym—Chinese Cantharidis). The sample was, therefore, considered suitable for use as a substitute in place of 'Cantharidis Pulvis'.

Interest was created in the identity of the beetles as these differed significantly in macroscopic and microscopic characters from either *Cantharis vesicatoria* Latr. of foreign origin or Mylabris species—*M. sidœ* Fab., *M. chicorii* Linn., and *M. Pustulata Thumb*—commonly seen and described as occurring in India and China. Further enquiry revealed that these beetles were collected during hot weather from areas in the United Provinces in the neighbourhood of the Bareilly District and were identified from two independent sources as a variety of Mylabris—*M. macilenta*.

Iyer and Guha[1] obtained about 2·3 per cent. total cantharidin and 1·35 per cent. of free cantharidin from dried *M. pustulata* beetles by employing a modified method of Dieterich.[2] By employing the ordinary B.P.C. method of assay, the cantharidin content of dried *M. macilenta* beetles came to 1·3 per cent. By employing a recent and more satisfactory method of extraction (Bodenstein[3]), the cantharidin content was found on an average (5 determinations with separate random samples) to be 1·8 per cent. The m.p. of the material (final residue) was recorded as 210-212° C. (uncorr.). Though recrystallisation from alcohol was attempted, the sharp m.p. of 212° C. of pure cantharidin crystals was not obtained. However, for all ordinary purposes, it would be correct to state that *M. macilenta* beetles con-

tained a cantharidin content of 1·8 per cent. For want of material, comparison with *M. pustulata* was not possible by the Bodenstein method (*loc. cit.*), but another variety of beetle gave a very much lower yield.

Those interested in cantharidin may look up to *M. macilenta* beetles to supply their needs during wartime certainly and possibly also later, as the Spanish fly, from all accounts, contains a definitely lower percentage of cantharidin.

Biochemical Standardisation Lab.,
Government of India,
110, Chittaranjan Avenue,
Calcutta,
November 7, 1944.

B. Mukerji.
T. Hossain.
B. A. Karim.

1. Iyer and Guha, *J. Ind. Inst. Sci.*, 1931, **14A**, **31.** 2. Dieterich, *J. Pharm.*, 1893 (5), **27**, 275; *J.C.S., A., i*, 1893, 600. 3. Bodenstein, *Analyst* **1943**, **68**, 238.

A PRELIMINARY STUDY OF THE BACTERIAL FLORA ASSOCIATED WITH SULPHUR DEPOSITS ON THE EAST COAST (MASULIPATAM)

The soil collected from the Masulipatam area was first passed through Molisch's Enrichment Medium composed of Peptone 5 gms., Dextrin or Glycerin 5 gms., Seawater 1,000 ml., and Agar 18 gms., and with a pH of 7·6. The slants were inoculated with the samples of soil and incubated at 30° C. for 72 hours. Profuse growth was observed after 24 hours. This culture was then transferred to McGreger and Skene's medium (composition: ammonium sulphate 0·75 gm., magnesium sulphate 0·05 gm., potassium dihydrogen phosphate 0·05 gm., potassium chloride 0·05 gm., calcium nitrate 0·01 gm., sodium chloride 27·0 gms., calcium carbonate 10·0 gms., and distilled water 1,000 ml., pH 7·6). This is a synthetic medium which is expected to promote the growth of only the obligate or facultive autotrophs. The medium (50 ml.) was placed in 150 ml. Erlenmeyer flasks, sterilised and incubated at 30° for 15 days. The growth on this medium was poor and some flasks showed no growth at all.

Plating trials in McGregor and Skene's agar medium followed by 48 hours' incubation at 30° yielded distinct colonies. They were transferred to McGregor and Skene's agar slants. Three such passages through a completely synthetic medium were expected to eliminate all saprophytic contaminants. The organisms thus isolated appeared to constitute a pure culture as judged by microscopic characters and reaction to staining.

From a total of five samples of soil 14 distinctive stock cultures were obtained. They were subjected to the following studies:—

Morphological: (*a*) *Microscopic observation.*—The culture was first passed through a liquid medium of McGregor and Skene's composition and 24-48 hour culture studied for motility and Gram staining. (*b*) *Growth.*—Growth on nutrient agar, wort agar, McGregor and Skene's agar and Van Delden's sodium lactate-asparagin agar were studied.

Biological.—Since the temperature of incubation and pH of media were maintained as nearly the same as occurred in soil, no special trials were made in this connection. Observations were, however, made in all solid cultures as to their ærophilic, micro-ærophilic or anærophilic nature.

Biochemical: (*a*) *Tolerance of H_2S.*—Two sets of Erlenmeyer flasks with necessary controls containing McGregor and Skene's medium were inoculated with the cultures. To one set 5 c.c. of a saturated solution H_2S in water was added on alternate days, and the other set incubated without any such addition. Most of the cultures survived the first two doses only. (*b*) *Nitrate reduction.*—The cultures were inoculated into a medium to test for their nitrate-reducing properties. After 48 hours' growth the reduction was tested by Glossway's method. A control for nitrate and one for nitrite was also run. (*c*) *H_2S production.*—The organisms were inoculated into nutrient agar to which 0·1 per cent. of a 10 per cent. lead acetate solution had been added. None of the cultures showed any production of H_2S.

Thiosulphate reduction.—Waksman's thiosulphate medium composed of sodium thiosulphate 5 gms., potassium dihydrogen phosphate 3 gms., ammonium chloride 0·1 gm., magnesium chloride 0·1 gm., calcium chloride 0·25 gm., and distilled water 1,000 ml., was inoculated and incubated for 72 hours. An aliquot was titrated against standard iodine solution using starch as an indicator. The uninoculated flasks served as the control. None of the cultures had utilised any thiosulphate.

In interpreting the data given in Table I the following observations are relevant: (1) The area from which the soil was collected is washed by the backwaters of the sea and is submerged under stagnating water during the monsoon. (2) During the dry season the soil cracks and deep fissures are created. (3) At a depth of 3 feet or more the soil strongly smells of sulphuretted hydrogen. (4) The soil is associated with layers of red ochre consisting largely of ferric oxide. (5) In places where watersprings can be dug out a vigorous evolution of gas (later identified as marsh gas) is observed. The most significant circumstance was the occurrence of H_2S in the deeper strata of the soil and it was thought that some of the organisms might require its presence for their metabolism.

Sulphates constitute an important source of H_2S. Since the transformation of sulphate to H_2S is uneconomical to microbial life in that this change does not give them any energy surplus, the phenomenon is not common. However Beijerinck[1] reported Spirillum desulpuricans and Vandelden[2] reported microspira æstuarii. The oxygen liberated during the reduction of sulphate by these organisms is used up in oxidising some organic matter as was shown by Van Delden who used sodium lactate for the purpose. At room temperature the reduction was brought about in 5-10 days. Elion[3] has reported another organism Vibrio thermodesulphuricans able to bring about the reduction in 12 hours incubated at 50° C. The production of H_2S from organic matter is a phenomenon of more frequent occurrence and a large number of Saprophytes are known to achieve this. The absence of any production

Culture No.	* Microscopic characters and gram staining	† Growth on media	§ Nitrate reduction
1	Thin long rods; some sporulated; motile; –ve	N + –; W – –; M.S. – – –; V.D. – – – –	++
2	Short rods; nonmotile; –ve	N – +; W – – –; M.S. – –; V.D. – –	+
3	Long spirally coiled rods; nonmotile; –ve	N –; W – –; M.S. – –; V.D. – –	++++
4	Thin long rods; nonmotile; +ve	N – – – –; W + – +; M.S. – – – +; V.D – – – – +	+
5	Short to medium rods motile; –ve	N – – +; W – – –; M.S. – – –; V.D. – – –	+ – +
6	Thin long rods; nonmotile; –ve	N – – +; W + –; M.S. – – –; V.D. + + +	+
7	Thick short rods; motile; +ve	N + + +; W + + +; M.S. + + +; V.D. + + +	+
8	Thick short rods almost of size of yeasts; normotile: –ve	N –; W +; M.S. + + +; V.D. + + +	+
9	Thin long rods with 3–4 granules in the cells; motile +ve	N + +; W + + +; M.S. + +; V.D. + + +	+
10	Thin long rods; nonmotile; –ve	N +; W + +; M.S. +; V.D + + +	++
11	Thin long rods; motile; –ve	N + +; W + + M.S. + –, V.D. + +	+
12	Thin rods motile (?) +ve	N – + +; W + + +; M.S. + + +; V.D. + + +	++
13	Short thin rod; motile; –ve	N + + +; W + + +; M.S. – + +; V.D. + + +	+
14	Medium thin rod; motile; –ve	N + + +; W + + +; M.S. + + +; V.D. + + +	++++

* Short 0·5–2μ; Medium 2·0μ–4·0μ; Long 4μ upwards.

† N—Nutrient agar; W—Wort agar. M.S.—McGregor and Shene's agar; V.D.—Vandelden's sodium lactate-asperagin agar. + Slight growth; ++++ Profuse growth.

§ + Slight pink; ++++ Intense red.

(No H_2S produced by any culture; No thiosulphate utilised and H_2S not tolerated.)
All cultures are aerophilic.

of H_2S by any one of the 14 cultures is probably due to the elimination of Saprophytes inherent to the methods of isolation described in the earlier portions of this paper. These Saprophytes are usually anærobes or microærophilis and perhaps therein lies the significance of the nitrate reducers which create a favourable environment for the saprophytes to thrive.

In the formation of elemental sulphur two well-defined stages appear to be involved. First, the production of H_2S by the deeper layers of the soil and second the oxidation of H_2S to yield sulphur. It is suggested that the reactive nitrite liberates sulphur from the H_2S thus formed—$KNO_2 + 3\ H_2S = KOH + 3\ S + NH_3 + H_2O$. The existence of powerful nitrite formers among the bacteria so far isolated lends significant support to the view that the above reaction may be operative in those strata where sulphur deposition occurs.

Section of Fermentation Technology,
Indian Institute of Science,
Bangalore,
November 7, 1944.

K. K. Iya.
M. Sreenivasaya.

1. Beijerinck, *Centralbl. f. Bakt., Abt. II*, Bd. 1. 1895, S.1, 49, 194 2. Van Delden, *Ibid.*, Bd. 11, 1904. S.81, 113. 3. Elion (Delft. Holland), *Ellis' Monograph on Sulphur Bacteria*, 1930.

PHOTOCHEMICAL ANALYSIS

Estimation of Ferric Salts

Recently Gopala Rao and Ramacharlu[1,2,3] have introduced a new technique into analytical chemistry. They are the first to employ the photochemical action of light as an aid to quantitative analysis. We have now found that ferric salts can be estimated with considerable ease and accuracy by the same technique, making use of the photochemical reaction between ferric salt and sodium oxalate in aqueous solution. In the dark, at laboratory temperatures, there is no appreciable reaction but on exposure to sunlight ferric salt is rapidly reduced to the ferrous salt. The results in the following table show that the reaction goes to quantitative completion in about ten minutes.

Table I

20 mls. of ferric alum solution (approx. N/20) + 20 mls. of N/10 sodium oxalate + 10 mls. of 4 N sulphuric acid

Time of exposure to sunlight	Amount of ferric iron reduced
5 minutes	0·036 gram
10 ,,	0·053 ,,
20 ,,	0·053 ,,
30 ,,	0·053 ,,
40 ,,	0·053 ,,
100 ,,	0·053 ,,

The reaction mixture is exposed to sunlight in a glass-stoppered wide-mouthed bottle or a Monax conical flask for the requisite time and the ferrous salt formed is estimated by titration with a standard solution of sodium vanadate using diphenyl amine reagent as the internal indicator, according to the method of Gopala Rao and Viswanadham.[4] It must be noted that dichromate cannot be employed for this titration, as the presence of oxalate interferes in the titration of ferrous salt by dichromate.[5] The standard solution of sodium vanadate is easily prepared and can be preserved for many months without alteration.[4]

We have made numerous estimations by the photochemical method now proposed, and the few typical results given below will show that there is good agreement between the amount of ferric iron determined by the photochemical method, and that found by the usual method—reduction with stannous chloride, etc., and the subsequent titration with a standard solution of potassium dichromate.

TABLE II

[illegible] mls. of *ferric alum solution*
— [illegible] mls. of *sodium oxalate solution*
— [illegible] mls. of *4 N sulphuric acid*
Exposed to sunlight for 30 minutes

Amount of ferric iron taken	Amount of ferric iron found by the photochemical method
0·01385 gram	0·01[illegible]72 gram
0·02681 ,,	0·02681 ,,
0·04271 ,,	0·04271 ,,
0·05327 ,,	0·05327 ,,

We have also found that the presence of hydrochloric acid or chlorides does not interfere with the photochemical method.

It will be realised that the photochemical method now proposed for the estimation of ferric salt is much more simple, easy and elegant than any of the other methods adopted at the present time..

G. GOPALA RAO.
V. MADHUSUDHANA RAO.

Andhra University, and
Andhra Christian College,
Guntur.
November 11, 1944.

1. Gopala Rao, G., and Rama[illegible], P. T., *Curr. Sci.* 1942, **11**, 162. 2. —, —, *Proc. Nat. Inst. Sci. (India)*, 1942, **8**, 383. 3. —, —, *Ibid.*, 1943, **9**, 67. 4. —, and Viswanatham, C. R., *Curr. Sci.*, 1944, **13**, 180. 5. —, —, *Ibid.*, 1943, **12**, 327.

A PRELIMINARY NOTE ON THE OCCURRENCE OF SULPHUR NEAR MANJHARA IN THE DEHRA DUN DISTRICT, UNITED PROVINCES

IT needs no emphasizing that sulphur is a mineral of great industrial importance and strategic value. Any occurrence, either large or small, is worthy of record. About one mile and 1½ furlongs, east of north of the sulphur spring of Sahasradhara[1] (30° 23′ 10″: 78° 7′ 48″), two streams join together to form a large stream. The eastern stream is called the Kali *Gad*. A little over one furlong north of the confluence on the right bank of the western stream, a large deposit of gypsum occurs associated mainly with an almost black dolomite, which is highly jointed and sometimes crumbles into a cindery gravel: Sulphur is found here (30° 24′ 15″ : 78° 8′) associated with gypsum and black dolomite.

The country-rock, in which the sulphur occurs, is very dark grey in colour. The weathered portion has a very rough, irregular surface. It has practically no reaction with dil. HCl but when treated with heated dil. HCl, it has a brisk effervescence and thus appears to be dolomite. The colour of the streak is grey and it is noteworthy that the rock on breaking or powdering emits a strong smell of H_2S. An average specific gravity of two specimens (containing very fine veins of gypsum) is 2·61.

This dolomitic rock, apart from the main gypsum deposit, is traversed by a network of white veins of gypsum. Associated with these white veins are to be seen small crystals or fine patches of native sulphur. In the white veins of gypsum, sometimes very fine stringers of yellow sulphur are to be observed. At times it appears that the gypsum has been deposited in the cavities of dark dolomite and sulphur is found associated with most of the small patches of gypsum. Sulphur occurs either in crystals or fine patches in the dolomite rock. It was found on breaking that the mineral occurs in the interior also. Sometimes, when a block of the dolomite was broken into a number of pieces it was observed that each piece had some sulphur associated with it. It, therefore, occurs associated with both gypsum and the dolomite rock and from its mode of occurrence it appears that the mineral was deposited in the native state along with the gypsum in the dolomite rock.

It is difficult to say anything about the exact commercial importance of this occurrence. Sulphur has been known to occur in fairly large quantities associated with gypsum. I was informed that during the quarrying of gypsum, small pieces of sulphur were found. Mr. S. Rai Pathak informed me that some of the pieces of sulphur weighed more than a pound. Mr. Pathak is an old resident of Dehra Dun and has been associated with the quarrying of gypsum in this area for a long time.

It has already been mentioned that the dolomite rock on breaking and powdering emits a very strong odour of H_2S. In this connection it may be noted that sulphur springs occur in this neighbourhood. One of them occurs above the left bank of the stream and opposite the place called Sahasradhara. This spring has a copious discharge so that a tiny stream issues forth from huge blocks, some of which are of the size of a small hut. I found that since my last visit two small tanks have been constructed for the bathing of the public. There is a fine white deposit of milk of sulphur and gypsum at the bottom of the tanks. The water smells strongly of H_2S. This is evidently a subterranean or a deep-seated spring. By the action of these circulating solutions on limestone, the deposits of gypsum of this area have been formed. The odour of hydrogen sulphide in the dolomite, perceived on breaking or powdering, is also due to the percolation of these solutions into the rock.

Sulphur, therefore, occurs at this locality in three forms: (*i*) as gypsum, (*ii*) in the native state, (*iii*) also in the dolomite rock. Besides, the occurrence of sulphur in the waters of the spring at Sahasradhara is also to be noted.

The locality is easily accessible and is only a few miles from Dehra Dun. In the dry season

motor lorries can ply as far as Sahasradhara and the main locality is hardly three miles by pony road from it.

Geology Department,
Lucknow University,
Lucknow,
November 8, 1944. H. L. Chhibber.

1. On the one inch sheet 53J/3 this place is spelt as Sansa Dhara but the correct spelling is Sahasradhara.

CATALYSIS IN VOLUMETRIC ANALYSIS

Estimation of Potassium Persulphate

If a reaction is to serve as the basis of a volumetric analytical process, it must be a very speedy one. While ordinarily very fast reactions only are selected for the purpose, some of the slowly occurring reactions have also been utilized on account of their convenience otherwise, the speed of reaction being increased by elevation of temperature. Only a few cases are on record where the speed of a reaction is increased for analytical purposes by the use of a suitable catalyst. Recently Gopala Rao and Ramacharlu[1] have employed sunlight or artificial light to accelerate a reaction so that it becomes suitable for purposes of quantitative analysis. It appeared to us that the phenomenon of catalysis can be utilized to a fuller advantage in volumetric analysis than has been the case hitherto. We have found that a suspension of cuprous iodide in water serves as an excellent catalyst for the reaction between potassium persulphate and potassium iodide and that the reaction so catalysed at room temperature is quite suitable for the iodimetric estimation of persulphate. The iodimetric method has the advantage that it is simple and accurate, giving directly a measure of the oxidizing power of persulphate. The methods now in use, with the exception of the iodimetric method of L. von Zombory,[2] are cumbrous. The alkalimetric method is based on the well-known reaction $2S_2O_8+2H_2O=4HSO_4+O_2$ which takes place rapidly at 100° C. This method is not suitable for the estimation of ammonium persulphate, as nitric acid and nitrogen are also obtained due to secondary reactions. Moreover, the method is vitiated by the presence of bisulphate in the original sample. The method of Le Blanc and Eckardt is an indirect one, being based on the fact that persulphates oxidize ferrous sulphate, the speed of the reaction being considerable when the latter is present in excess.

The cuprous iodide catalyst used in our experiments was prepared by adding a slight excess of potassium iodide to a known quantity of pure copper sulphate (Merck, A.R. sample) in dilute solution, washing the precipitate obtained repeatedly by decantation with water until free from all traces of free iodine. The cuprous iodide thus prepared was suspended in water and the suspension made to a known volume and preserved in a wide-mouthed glass-stoppered bottle. This was found to be quite stable for several months, no trace of iodine or cupric salt appearing. The suspension used in our experiments contained approximately 0·015 gm. of cuprous iodide per millilitre. The results recorded in Table I demonstrate the catalytic action of cuprous iodide.

Table I

15 ml. of potassium persulphate solution + 20 ml. of 0·125 Molar potassium iodide solution Amount of persulphate taken = 0·1014 gm.

Time in minutes	Amount of persulphate reacted	
	Without catalyst	With 2 ml of cuprous iodide suspension
10	0·01624 gram	0·08672 gram
20	0·02581 ,,	0·08692 ,,
40	0·03643 ,,	0·08754 ,,
60	0·04591 ,,	0·08816 ,,
80	0·05267 ,,	0·08869 ,,
100	0·05603 ,,	0·08900 ,,

The catalytic action of cuprous iodide has been applied to the volumetric determination of persulphate in the following manner. 20 mls. of the persulphate solution are placed in a glass-stoppered bottle or Erlenmeyer flask, 20 mls. of potassium iodide solution (M/2) are added, followed by 5 mls. of the cuprous iodide suspension. The bottle or flask is kept stoppered for ten to fifteen minutes and the iodine liberated is titrated with a standard solution of sodium thiosulphate. The results are given in column 1 of Table II. These compare very favourably with those in column 2, the latter being obtained by the method of Zombory.[2] For the estimation of persulphate by our method, it is desirable to have the iodide at a concentration, 20 to 50 times that of the persulphate.

Table II

Amount of Persulphate Found

Authors' method (15 minutes)	Zambory method (30 minutes)
0·13340 gram	0·13340 gram
0·10100 ,,	0·10100 ,,
0·03684 ,,	0·03656 ,,
0·05386 ,,	0·05399 ,,
0·01823 ,,	0·01828 ,,

Thus it will be observed that our method requires a much shorter time than that of Zombory. We have found that silver, mercuric, cerous, cobalt, nickel and manganous salts do not catalyse the reaction between persulphate and iodide either in neutral or ecid medium, while ferrous and ferric salts are good catalysts.

G. Gopala Rao.
J. V. S. Ramanjaneyulu.
V. Madhusudhana Rao.
Andhra University, and
Andhra Christian College,
Guntur,
November 17, 1944.

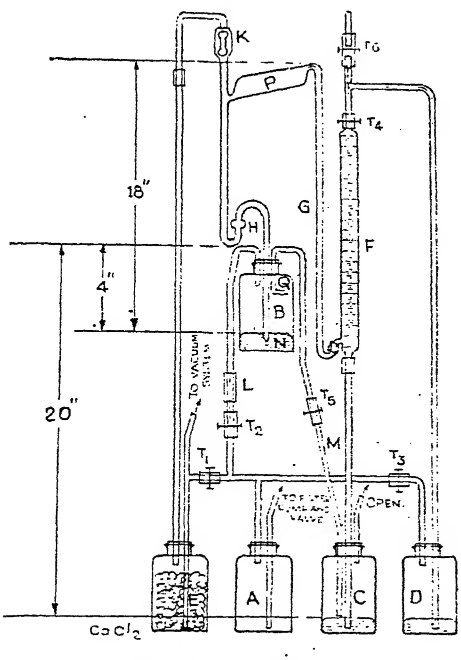
1. Gopala Rao, G., and Ramacharlu, P. T., *Curr. Sci.*, 1942, **11**, 102; *Proc. Nat. Inst. Sci.* (India), 1942, **8**, 383; *Ibid.*. 1943 **9**, 67, 4. 2. Zambory, L., *Von. Z. Anal. Chem.*, 1928, **73**, 217.

AUTOMATIC TÖPLER PUMP

THE following description is given of an improvised automatic Töpler pump which has proved successful in use. In view of the shortage of good glass stopcocks, pinchcocks have been used throughout. The bottles and tubings employed are those commonly employed in a laboratory. The glass-blowing has been reduced to a minimum. F is taken from a broken burette. In the following design the automatic system of the Töpler is worked by a filter pump.

N H K P G is one piece of glass consisting of the usual Töpler P and valve K, H a bulb for trapping creepage, N, a constricted end to obviate knock. The bend at Q prevents splash of mercury and consequent creepage of air into P. A 1-1½ mm. quill tubing serves well for G and is more flexible than the usual capillary.

During the upstroke, mercury follows the gas from P *via* G into F and then enters C. The level in C rises, seals the bottom end of M, thereby closing B from the atmosphere. The filter pump, running continuously, is now able to evacuate B *via* A and the leak T_2; with the fall of pressure in B, all the excess mercury that had flown into C, is lifted back to B *via* M. Also the mercury in P comes



AUTOMATIC TÖPLER PUMP

down, whereby E and P are connected ready for the upstroke. When all the excess mercury is lifted back to B, the bottom end of M is open, whereby air enters B to atmospheric pressure. This starts the upstroke in P and the cycle repeats. During the upstroke with the bottom end of M open, and the small leak T_2, the pressure in B is substantially atmospheric.

To start the pump, T_5 and T_6 are closed, T_1, T_2, T_3 and T_4 are opened and the filter pump started. When exhausted to the limit T_1 is closed, T_2 is partly closed and T_5 then opened. The pump starts automatically. To stop the pump, the above procedure is reversed. When E and the experimental system are well evacuated, T_3 may be closed, for collecting larger samples of gas from the pump. T_4 is closed when quantitative measurements of smaller quantities of gases are necessary. F is graduated for the purpose. It may be advantageous in some cases to replace the screw pinch T_4, by a suitable two-way glass tap. T_6 allows sampling of the gas from F. The mercury at the bottom of D serves as a valve during the intermittent action of B. T_2 controls the frequency of strokes. Further reduction in frequency may be effected by a fine-bore capillary tubing L in the line. The various levels marked in the diagram are somewhat critical for smooth and efficient running of the pump.

We are indebted to Dr. H. R. Ambler, PH.D., F.R.I.C., Chief Inspector of Military Explosives, for his valuable suggestions and to the Director of Armaments for permission to publish the note.

Inspectorate of Military Explosives, Kirkee, *November* 15, 1944.

B. N. MITRA.
G. SIVARAMAKRISHNAN.

ESTIMATION OF PYRIDINE AND AMMONIA IN A MIXTURE IN DILUTE SOLUTIONS

AMMONIUM salts of coal-tar origin often contain traces of pyridine. There has as yet been no entirely satisfactory method of carrying out the estimation of small quantities of pyridine in presence of ammonia. Acidimetric titration fails for want of a suitable indicator as will differentiate pyridine from ammonia, while colorimetric methods, though sensitive, are not accurate enough. Differential electrometric titrations described below, have been found to provide an accurate method for the estimation of pyridine in ammonia.

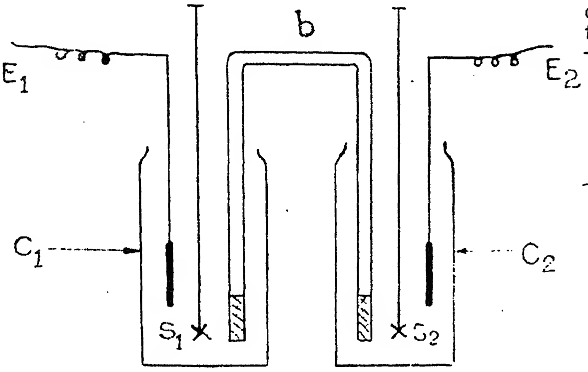
APPARATUS

E_1, E_2 are antimony electrodes, C_1, C_2 titration flasks, S_1, S_2 stirrers, *b* KCl-bridge with ends plugged with filter paper. Separate burettes containing N/50 acid are used for each titration flask. The stirrers, electrodes and bridge are mounted compactly on a wooden stand which also supports the two burettes. The titration flasks are inserted from below and supported by wooden blocks. E_1 and E_2 are connected through a tap key to the terminals of a millivoltmeter reading directly to 1/5 mv. The tap key is used only momentarily for taking readings which are well repeatable if polarisation is avoided.

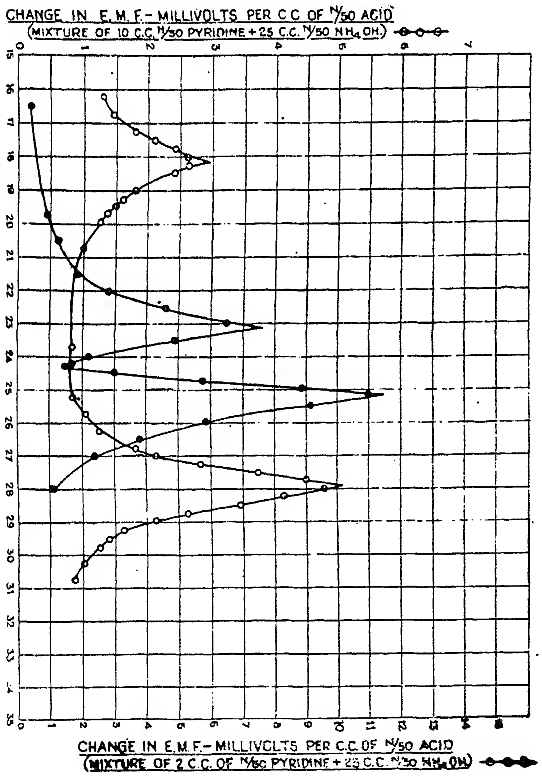
PROCEDURE

The pyridine is separated from the bulk of ammonium salts by distillation with a little alkali. Aliquot portions of the distillate are placed in C_1 and C_2 and the stirrers started. It is generally found necessary to increase the coductivity of these dilute solutions for good working. Purest KCl or NaCl, tested to be

neutral, was found suitable and about 2-10 per cent. may be added in equal quantities to both cells. The millivoltmeter is now read.



To C_1 1 c.c. of N/50 HCl is added, and the millivoltmeter reading again taken. To C_2 1 c.c. of N/50 acid is added from its burette.



The reading is repeated. Alternate additions are made to C_1 and C_2, noting the deflections for every c.c. added.

The deflections per c.c. $\left(\frac{\partial e}{\partial v}\right)$ are plotted against v, the volume of acid added. Typical curves are shown. These curves reveal two characteristic peaks. The difference between the peaks is equal to the quantity of pyridine added. Some results obtained for known mixtures are given below.

The method is independent of arbitrary end points in titrations. Further applications of the method to inspection of weak acids and bases in textiles, paper, rubber, leather and other organic materials are under investigation.

Quantities present in the mixture in c.c. of N/50		Pyridine found in c.c. of N/50		
			By difference between end points with phenolphthalein and	
NH_4OH	Pyridine	By the present method	Bromocresol green	Congo red
25·0	25·0	24·8±0·2	26·0–27·2	26·2–28·4
25·0	10·0	9·8±0·2	12·3–12·9	12·1–13·9
25·0	5·0	5·2±0·2	7·3–9·1	7·3–9·5
25·0	2·0	2·1±0·2	4·7–6·2	4·8–6·4
0·0	10·0	9·7±0·2	9·5–9·7	9·0–10·1
0·0	2·0	2·2±0·2	1·9–2·0	1·8–2·4

Our thanks are due to Dr. H. R. Ambler, Ph.D., F.R.I.C., for his keen interest in the work and to the Director of Armaments for permission to publish it.

Inspectorate of Military Explosives, Kirkee,
November 15, 1944.
B. N. MITRA.
G. SIVARAMAKRISHNAN.

LINKAGE RELATIONS OF THE li_d GENE FOR LINTLESSNESS IN ASIATIC COTTONS

THE appearance and the inheritance of the Baroda lintless mutant was reported earlier in this *Journal* (Govande, 1944) when it was shown that this and the Viramgam lintless mutant represent independent mutations at the same locus and that the new gene designated as *lid* was distinct from and complementary to a majority of other lintless mutants so far reported. This gene has been further studied to find out its linkage relationships with other known genes. The Baroda lintless was crossed for this reason with the white pollen mutant Cocanada 45, the Burma laciniated A8 and a new multiple recessive isolated at this Station from a cross of N6 multiple recessive with Cocanada 45.

The F_1 hybrids were fully dominant for the characters concerned. F_2s and F_3s were grown in the Baroda lintless × A8 crosses and though no F_2s were grown in other two cases, back-crosses to both the parents involved were available for confirming the single factor segregations. The summary of the results is given in Table I.

That the whole of the discrepancy in each one of the cases where χ^2 is significant was due to linkage and not due to any disturbance in the single factor ratios was confirmed by partitioning χ^2 for the three degrees of freedom into its components (Fisher, 1936) when

TABLE I

[illegible]-factor ratios of crosses of *Baroda lintless* with *Cocanada* 45, *A8* and the *New multiple recessive*

		Lintless	Linted X	Linted x	Lintless X	Lintless x	Total	χ^2	P	Cross-over
			obs							
Baroda lintless × Cocanada 45	F_2	[illegible]	[illegible]	[illegible]7	33	9	212	4·285	0·3–0·2	
		[illegible]	137	33	31	11	212	6·096	0·2–0·1	
× New multiple recessive	F_2	[illegible]	159	50	53	18	28[illegible]	0·[illegible]52	0·9[illegible]–0·98	
..	..	[illegible]	155	54	48	23	280	2·197	0·7–0·5	
..	..	[illegible]	1[illegible]6	[illegible]3	5[illegible]	21	280	0·[illegible]3[illegible]	0·9–0·8	
..	..	[illegible]	153	56	48	23	280	2·476	0·5–0·3	
× A8	F_2	[illegible]	199	18	28	45	290	84·836	< 0·01	17·9
	F_3	..	207	24	22	54	307	111·519	< 0·01	16·3
										*17·05 ± 1·72
	F_2	[illegible]	198	18	29	45	290	83·480	< 0·01	18·3
	F_3	..	172	14	23	52	261	121·799	< 0·01	14·8
										*20·46 ± 1·97
		Leaf shape	Narrow		Broad					
	F_2	[illegible]	182	35	34	39	29[illegible]	40·765	< 0·01	27·4
..	F_3	..	160	36	26	39	261	46·910	< 0·01	26·4
										*26·93 ± 2·28

* [illegible] F_2 and F_3 data.

[illegible] degree of freedom alone was found [illegible] large and significant in all [illegible]. The results show that the [illegible] gene [illegible] in the Baroda lintless mutant [illegible] leaf-shape locus with a cross-over [illegible] 17·05 per cent. ± 1·72 and with [illegible] with a cross-over value of 20·46 per cent. ± 1·97. The leaf-shape gene [illegible] colour gene with a cross-over value of 26·93 per cent. ± 2·28 and con-[illegible] previously reported by [illegible] (1934) with a cross-over value of [illegible] per cent. Since the cross-over [illegible] the Baroda lintless gene with [illegible] colour gene is nearly [illegible] of the new gene is somewhere [illegible] between the L and Lc. genes.

As regards [illegible] genes, namely, those for [illegible] colour, petal colour and [illegible] the deviations from the expected [illegible] are not significant and indicate occurrence [illegible] assortment between these and lintless-[illegible].

Economic Botanist

Baroda,

November 18, 1944.

G. K. GOVANDE.

1. [illegible] 2. G[illegible], G. K., [illegible] 1944, 13, 15. 3. Hutchinson, J. B., *Journ. Gen.*, 1934, 28, 437.

CONCENTRATION OF *HEVEA LATEX* BY CREAMING AGENTS

TRAUBE had investigated the efficiency of many vegetable colloids to cream latex and his patent covers all vegetable mucilages in general and specially those extracted from carragheen and Iceland mosses.

The above invention gave an impetus to others to study the creaming efficiency of gum Arabic, gum tragacanth, gum karaya, Algeinic acid, alginates and also materials containing hemicelluloses such as oat, wheat and barley straws; castor, rape, cotton, soya beans, groundnut and linseed meals; bean pods, copra, saw dust, methylated starches; and the gums extracted from certain thickened roots.

Researches by the United States Rubber Company have resulted in the addition to the above list the vegetable colloids obtained from the seeds of plants of several botanical species specially the Leguminosæ.

Experiments on creaming were carried out in the Travancore Rubber Works Laboratory in 1941-42 and it was found that the gums extracted from the leaves and bark of certain plants, specially Laurineæ Sebifera and Malabar Vayana, were able to cream the latex. Since the extraction of the creaming agent from large quantities of plant material was tedious and not practicable commercially further studies were dropped.

The mucilage obtained by cold or hot water extraction of the seed cover of *Trigonella fœnumgrœcum* was noted to cream latex very efficiently. The mucilage was prepared by immersing the seeds for about two days in water, boiling for about two hours and then filtering off the coteledons through cloth. The thick mucilage was mixed with latex of D.R.C. 35 per cent. and the mixture was heated to 50° C. and left undisturbed in a glass jar. Heavy curdling took place in about 30 minutes and in the course of about 6-8 hours cream of D.R.C. 58 per cent. and a lower layer of serum having a D.R.C. 0·2 per cent. were formed. A sample of cream obtained after four days' creaming had a D.R.C. of 63 per cent. This creaming agent is more efficient than the best creaming agent, sodium alginate. The creaming agent looses its colloidal state by keeping for more than four days and is not efficient thereafter. The gum extracted from 1 lb. of the seed is able to cream about 8 gallons of latex. The cream keeps well for months and the traces of creaming agent do not adversely effect the stability of the latex. It can be easily compounded with chemicals to manufacture dipped goods. The creaming agent is not efficient to cream *Cryptostegia latex*.

My thanks are due to Mr. P. R. Narayanan, B.SC., for his assistance; and to the management of the Travancore Rubber Works for the facilities given to me.

New Delhi, A. K. M. PILLAI.
November 1944.

ON A NEW RECORD OF AN INSECT—BORER OF 'AMLA' (*PHYLLANTHUS EMBLICA*, L.)

DAMAGE was done to a number of plants by a moth at Shivajinagar in Poona during August-September 1944. It was observed that a few trees ranging from 1 to 3 feet in circumference were having bored holes in their trunk 2 feet above the ground-level. These holes were 2 to 3 inches deep, measured 0·4 inch in diameter at the openings, and had a silken web covering the entrance.

The observations were done from 15-8-1944 to 15-9-1944. The maximum temperature during this period was 33° C., the minimum 22° C., and the average humidity was 72 per cent. at 11 a.m.

Shiny, black moths, with yellow stripes on the abdomen, and golden yellow marks on the neck, thorax, and wing bases emerged nearly each day between 10 a.m. and 1 p.m. There was no emergence before or after this time. The pupa wriggled up to the entrance and the moth came out through the broken silken covering of the entrance. It was a very sluggish flier and attempts to breed it in the laboratories have failed. It was not traced to breed on any plants in the locality, during or after the above period of observation.

This moth has been identified to be *Paranthrene chrysochloris* Hmpsn. There is no rcord of the occurrence of this moth on Amla (*Phyllanthus emblica* L.). Amla is a crop of economic importance in our forests, and the importance of its fruits as a great source of vitamin C has been shown by a number of workers (Srinivasan, 1944[1]). It remains to be seen whether this has been noticed doing similar damage elsewhere. I was shown the observations on this very moth on this very tree during the same months and time taken in 1937. I am told by the reliable observer that no such damage was seen, neither this moth observed on this tree between 1937-1944. It thus remains to be seen whether similar gap of time is seen elsewhere in this moth on Amla. It may be suggested that if there are such regular gaps seen, then a periodicity as shown by Roonwal[2] (1944) may be indicated.

I am extremely thankful to Mr. J. C. M. Gardner, Entomologist, Forest Research Institute, Dehra Dun, for the identifications and information. Mr. H. P. Paranjpey, Retired Horticulturist, Poona, very kindly brought the damage to my notice and gave me all help in the observations.

Zoology Department, P. J. DEORAS.
Fergusson College,
Poona 4,
November 23, 1944.

1 *Nature* (3832), 1944, **153**, 684. 2. *Curr. Sci.*, 1944, **13**, (5), 135.

EVALUATION OF PEPTONE SUITABLE FOR PARENTERAL THERAPY

PEPTONE solution for parenteral administration is generally used for non-specific protein therapy. But it is not known on what compositions of such peptones, the therapeutic efficacy would depend. Accordingly, work in this direction has been undertaken in this laboratory and working with Witte's peptone and its fractionated primary and secondary proteoses prepared by ammonium sulphate precipitation and subsequent dialysis, it is being noticed that both the fractions along with the original whole Witte's peptone solution produce more or less pyrogenic reactions in rabbits. The solutions were all injected intravenously in equivalent doses in terms of nitrogen. The primary proteose fraction, however, gives rise to two distinct type of reactions which can be readily detected. One is an anaphylactoid shock reaction leading to hurried respiration followed by slow stertorous breathing, loss of sphincter control with involuntary micturition and defaecation, and loss of muscle tone developing into a flaccid paralysis of the hind legs. The other type is a hyper-pyrexial reaction causing severe rise in the body temperature (4° F. or more above the normal). It has been found that severity of these two types of reaction vary with the dose of primary fraction injected. Thus, with the higher doses (from 5·0 c.c. to 10 c.c. per kg. ≡ 25 to 50 mgm. nitrogen per kg.) the anaphylactoid reactions become more prominent and the hyper-pyrexial reaction is only a temporary one. But with the lower doses (2·5 c.c. to 5 c.c. per kg. ≡ 12 mgm. to 50 mgm. nitrogen) anaphylactoid reaction is absent, but there is a severe hyper-pyrexial reaction. This hyper-pyrexial reaction, of course, diminishes with the dose and merges into the pyrexial reaction,

which is of course associated with injection of all peptone solutions. In the cases of secondary proteose fraction and Witte's peptone whole solution, the reactions obtained are of the usual pyrexial type.

From the antigenicity tests in guineapigs, it is found that none of the fractions gave rise to any anaphylactic sensitization which was, however, invariably produced in animals injected with egg albumin.

Further work is in progress to find out which fraction would be of therapeutic value and what type of reaction could be taken as an index of therapeutic activity so far as its power of leucocytic mobilisation is concerned.

Bengal Immunity Research Laboratory, Calcutta,
November 30, 1944.

S. N. SEN.
A. N. BOSE.

A SIMPLE HIGH IMPEDANCE VOLTMETER

DUE to its versatility the vacuum tube in its manifold forms has lent itself to a veriety of circuits for electrical measurements, particularly of voltages across high impedance sources. The circuit described here was developed in connection with the design of a sound intensity meter by one of us (N. B. B.) for accoustical measurements in the laboratory using a d.c. microammeter which was available as the indicating meter. Fig. 1 shows the circuit em-

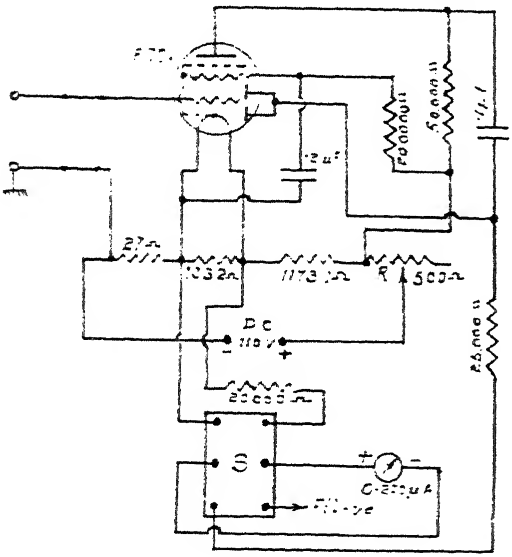


FIG. 1

ployed using a diodepentode tube in rather an unconventional way of preceding the diode part by the pentode stage for which the diode portion along with the indicating meter forms a part of the load. This offers the obvious advantage for a voltmeter circuit which should ideally have an infinite input impedance at all frequencies: the high input impedance of the pentode section is not seriously impaired by the load and its lower input capacitance offers a wider uniform frequency response.

Fig. 2 shows the calibration curve, using RCA type IF7GV tube, which is a straight line for the whole range; full scale deflection corresponds to an input of about 2·4 volts. Any further increase in the input voltage results in distortion introduced by the pentode

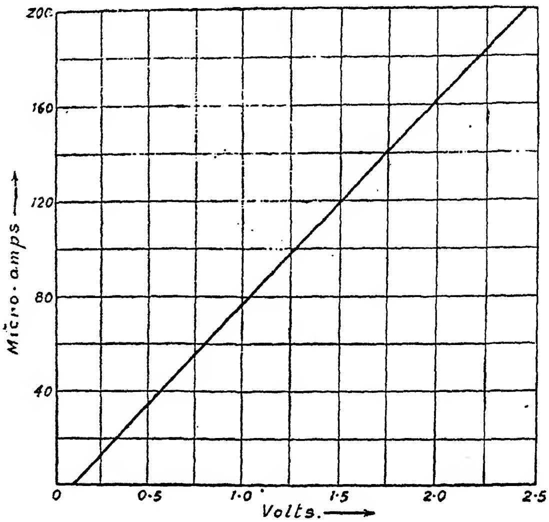


FIG. 2

stage. Hence for higher ranges, multiplier resistances should be used but they must have higher values so as not to bring down the input impedance of the voltmeter. The lower ranges of voltage will necessitate an additional pentode stage for amplification ahead of the voltmeter. Both these can easily be rigged up so that the voltmeter essentially works within the range specified by the curve in Fig. 2, which has been found the same for frequencies between 60 c.p.s and above 10,000 c.p.s.

The instrument is designed to work on 110 volt d.c. supply available in the laboratory but its low current consumption of about 80 m.a. will permit a dry battery operation, if necessary. The switch S (Fig. 1) is provided to check the correct operating voltage across the filament of the tube, which is read on the same meter; this operation simultaneously ensures the correct plate and grid bias voltages. The entire circuit is assembled in an aluminium box 6″ × 5″ × 4″ in overall dimensions. Besides the switch the only control on the panel is a potentiometer which controls the supply voltage.

Recently T. A. Ledward has desecribed a voltmeter (*Wireless World*, Vol. L, 162, 1944 June) employing a similar idea using two diode-pentode tubes in a bridge circuit for essentially the same performance offered by the much simpler circuit described here with its modest demands on components, power consumption and attention.

Electroacoustics.
Dept. of Electrical Technology,
Indian Institute of Science,
Bangalore,
December 14, 1944.

N. B. BHATT.
B. SUBRAMANIAN.

REVIEWS

Flood Estimation and Control. By B. D. Richards, B.SC., M.Inst.C.E. (Chapman and Hall, Ltd., 11, Henrietta Street, London, W.C. 2), 1944. Pp. 152. Price 16s. net.

To those interested in floods and especially the relationship between rainfall and run-off, this very clearly written book by B. D. Richards will be most helpful. The various factors which affect run-off and their relative effects are considered mathematically, basing the intensity of flood discharges on the period of concentration and the reduction of intensity of flood contributed by each part of a catchment as a result of the damping effect of the various factors, and he shows how to work out the maximum discharge by making assumptions and he also works out the percentage error likely to result from errors in each assumption. Rainfall intensity is a function of both time and area, and run-off is affected by the size, direction of movement, distribution and duration of storms, the area of the catchment, its shape, slope, initial state of wetness and coefficient of run-off—which is dependent on the nature of the catchment. These he calls the six major factors affecting floods; but their relative importance varies widely.

The mathematical treatment, which is easy to follow, is both interesting and instructive. It brings out clearly the fact that our prediction of storms must depend mainly on experience and data applicable to areas with similar characteristics. In those parts of India where heavy storms occur, we can, to a large extent neglect wetness of catchment and slope, and even the catchment characteristics—*i.e.*, whether afforested, cropped, or bare—because these make little difference under cloud-burst conditions, especially in the case of fan-shaped catchments, when area becomes the predominant factor. Consequently in India formulas of the type Run-off $= CP^n$ are widely used—where P is weighted mean precipitation and n is an exponent varying in different formulas from $\frac{1}{2}$ to $\frac{2}{3}$. In catchments which differ considerably from fan-pattern, it is necessary to take shape into account, because it affects the time of concentration and may be a very important factor. The area of storms relative to the catchment area and the direction of movement are also important in India in the case of large catchments.

The author, who used to be in India but is now working in England, has written the book to cover conditions in Britain, where storms are relatively restricted in area and rainfall generally much less intense than in India.

Under such conditions assumptions must necessarily be widely different from those in India; but it is probable that even in Britain a formula of the simple type [Annual Run-off in inches $= C(P - 12'')$] will be found useful. In the Western Ghats of India, where the rainfall is 100″ to 300″ in three months, $C = \cdot 85$.

Flood control by storages and the effect of soil erosion on the regime of rivers are dealt with briefly but adequately. The print and illustrations are exceptionally clear. The book opens wide and remains open where desired. In fact the publishers deserve great credit for the production.

C. C. Inglis.

The Fortunes of Primitive Tribes. By D. N. Majumdar. (The Universal Publishers Ltd., Lucknow, 1944. Price Rs. 12.

Dr. D. N. Majumdar undertook an ethnographic, anthropometric and blood group survey of the United Provinces at the time of the Census operations in 1941. The results are now being worked out, the volume before us being the first of the four volumes projected. Mr. Bhagvan Sahay, I.C.S., Superintendent of Census Operations, Dr. Majumdar and the authorities of the Lucknow University, deserve the thanks of all anthropologists in and outside India for making available to them these full accounts of several cis-Himalayan tribes about whom our information is so meagre. Comparisons are to be avoided in a review, but the reviewer cannot resist the temptation to compare the anthropological results of other provincial surveys to those of the United Provinces and point out that whereas the former are either nil or ridiculously inadequate or amateurish, the latter are as sumptuous as one would wish. Anthropologists have been asking in the past for the establishment of a permanent ethnographic survey of India associated with a permanent census bureau on the American model, but in the absence of such an ethnographic establishment, what the U.P. Government have done is the second best arrangement. Dr. Majumdar is well-known to the readers of *Current Science*, so that there is little need for the reviewer to go into details regarding the quality of his work. In an introductory chapter, Dr. Majumdar explains the implications of the race concept and its application to Indian communities. In the following chapters, the ethnology, bodily characters and blood groups of the Korwas, the Tharus and the Khasiyas are discussed. Brief descriptions are given of a few of the numerous criminal tribes of the Province. The most important chapter is the last one on "Tribal Cultures and Social Vigilance" wherein the psychology of culture change and adaptation is considered with great insight. A word of praise is due to the publishers who have managed, in spite of war-time difficulties, to render the volume artistically pleasing.

A. Aiyappan.

RECENT ADVANCES IN BIOCHEMISTRY*

THE present war has provided a powerful incentive to greater endeavour in certain fields of research, represented by physiology, general biochemistry, nutrition and medicine. Wider opportunities, greater variety of research material not ordinarily available, ungrudging and generous financial support and increasing State recognition and public appreciation of the indispensability of science for modern warfare, these factors have conspired to accelerate the progress of certain branches of science, which the world has been witnessing to-day. The fruits of these intensive labours carried out in laboratories of the belligerent Nations, are partially reflected in the Annual Reviews of Biochemistry. Much of the work must, for strategic reasons, await the return of peace while a substantial portion of the research published in the axis countries is not easily accessible.

In spite of these circumstances, the review for the year 1944 continues to portray a steady record of progress in the field of Biochemistry. Of the twenty-six topics discussed in the volume, no less than twenty-two are reviewed by American investigators, a significant circumstance which is indicative of the fact that to-day, the United States offers the most propitious and the most serene atmosphere for the prosecution of scientific research and for the promotion of scientific thought.

Biological oxidation and reduction has been reviewed by D. E. Green who has made substantial contributions to this field. The position of iron porphyrin enzyme complexes has been clarified and reference has been made to the possibly close relationship of flavoprotein systems with antibacterial agents. Two more coenzymes, different from any so far known, associated with lysine decarboxylase and aspartic transaminase systems, have been described. The physiological significance of acetyl phosphate discovered by Lipmann has been further elucidated. The author has discussed the citric acid cycle of Krebs in the light of recent work. The non-oxidative enzymes are reviewed by The Manns who have given a stimulating review of the eleven enzyme complexes of established integrity engaged in carbohydrate metabolism. Special attention should be drawn to the enzyme-like diffusing factors which are coming into prominence. The enzymes concerned with the utilisation, liberation and transport of CO_2, have received adequate attention.

The recent methods of the isolation and determination of amino acids in protein hydrolysates, are reviewed by Neurath and Greenstein. This includes the promising chromatographic and microbiological methods of separation and estimation as also the methods of isotopic analysis. A new and fruitful departure is the estimation of certain amino acids on intact protein without hydrolysing it. This procedure is obviously of fundamental value in elucidating the nature of the reactive groups determining its biochemical activity.

The chemistry and metabolism of the compounds of phosphorus is the topic of a detailed review by Green and Colowick. The field of carbohydrate, fat and protein metabolisms are as usual covered by three separate reviews. Indications that certain amino acids may eventually prove to be the precursors of certain vitamins in their biological syntheses are gradually unfolding themselves. The action of certain powerful drugs like sulphanilamides on biochemical reactions potentiated by enzymes and vitamins are discussed in the review on Water-Soluble Vitamins. Evidence regarding the existence of two more fat-soluble vitamins are presented in the review on Fat-Soluble Vitamins. One of them whose deficiency causes wrist stiffness and which is associated with raw cream has been obtained in a concentrated form.

The nutritional deficiencies in Farm Mammals is a subject of topical interest in view of the post-war restocking and breeding of herds which have been slaughtered or destroyed. It is of particular interest to India where the nutritional status of our stocks are depressingly poor, and where the "infant" mortality among our calves is appallingly high (50 per cent.). This topic forms the subject of an instructive review by Huffman and Duncan.

Biochemistry of fungi has been reviewed from a new and stimulating angle. "In the light of recent research showing that certain biochemical activities of the mold *Neurospora* are controlled by specific genes, it seems reasonable that similar genetic controls are responsible for many of the varied biochemical avtivities of fungi." The review represents a praiseworthy attempt at correlating recent developments in the biochemistry of fungi with this general concept.

David Glick who is a well-known figure in the field of micro- and ultramicro-chemistry, contributes a comprehensive and valuable review on histochemistry. Other reviews include those pertaining to Chloroplast Pigments, by H. H. Strain; Mineral Nutrition of Plants, by F. J. Richards; Growth-Regulating Substances in Plants, by J. Van Overbeek; Photoperiodism in Plants, by Karl C. Hamner; Synthetic Drugs—Antispasmodics, by F. F. Blicke; Alkaloids, by R. H. F. Manske; Chemistry of Harmones, by H. Jensen; Mineral Metabolism, by McCance and Widdowson; Biochemistry of Nucleic Acids, by Loring; and Steroids, by Koch.

The standard of the *Review* to which readers all the world over are accustomed has been maintained and Dr. Luck, the Founder-Editor, deserves the gratitude of all investigators in the field of Biochemistry to whom the Review continues to offer an unfailing source of stimulus and inspiration.

---

* Annual Review of Biochemistry, Vol. XIII, Edited by James Murray Luck and J. H. C. Smith (Annual Reviews, Inc., California), 1944. pp. ix + 795. Price $ 5·00.

DRY FARMING IN INDIA*

OVER large parts of India, the greater proportion of crop production is solely dependent upon the sufficiency and effectiveness of the monsoon rains. Unfortunately, in many tracts, particularly in Bombay, Madras and the Punjab, and in the States of Rajputana, Hyderabad and Mysore, the annual rainfall is not only uncertain in quantity but also often badly distributed as regards crop requirements throughout the year. This condition results in frequent crop failures leading to periodic scarcities and famines. The problem of preventing crop failures in these 'scarcity' tracts is of a twofold nature. In the first place, it becomes necessary to work out a scientific system of dry farming whereby crops can be grown with a fair measure of success in years in which the annual rainfall is low and precarious. Secondly, the immense losses of the cultivator's main capital, the soil, which result from the continuous erosion by rain-water after heavy and untimely precipitations, must be checked and necessary measures taken to prevent such run-off and erosion.

Scientific research into the problems of dry farming has occupied the attention of agricultural scientists for many years and in all parts of the world. In India, a systematic approach to the problem was made possible only about a decade ago when the Imperial Council of Agricultural Research initiated certain co-ordinated schemes of research on the subject in the different provinces of Bombay, Madras, Hyderabad and the Punjab. The Bombay scheme was started in 1933 at Sholapur and Bijapur, centres of famine tract. The work at Madras was started at Hagari near Bellary in 1934 and, in the Hyderabad State, at Raichur also in that year. The Punjab scheme was carried out at Rohtak from 1935. The publication under review presents a critical account of all the data and of the results which have so far emerged from the work of these five Dry Farming Research Stations in the country.

The five experimental stations represent two rather widely different tracts in India which are the 'problem areas'. Rohtak is typical of the northern dry zone while the four stations in the south represent the great plateau of peninsular India. The results of the investigations reported in this publication can, therefore, be conveniently reviewed separately for the two areas.

The scarcity tract of Northern India consists of extensive alluvial plains comprising parts of the Punjab, Rajputana, Sind and the North-West Frontier Province. The rainfall is usually low, is characterized by long breaks and is mostly received from the south-west monsoon during the three months from July to September. The climate is desiccating, due to high temperatures, even during the monsoon months. The soils are alluvial in origin and consist of level plains with great depths; on account of their porous character, even small showers of rain are absorbed and the water penetrates easily to lower depths. Soil erosion by rain-water is not, therefore, very serious in this tract although, in some places, wind erosion is met with. The dry farming problem of this tract is thus principally one of conserving soil moisture.

The findings of the investigations at Rohtak indicate that this water problem can be effectively tackled and crops secured by (*a*) bunding of the land and division into compartments, (*b*) shallow ploughing after the first rains, (*c*) repeated shallow ploughing, during breaks in the monsoon, by *sohaging* (*i.e.*, compacting of the soil with a wooden implement of *sohag*) till the sowing of the *bajri* or *guara*, (*d*) wider and thinner sowing, (*e*) addition of farmyard manure, (*f*) mulching by repeated inter-culture, and (*g*) keeping a part of the land fallow for a full year and taking a crop in the following year.

The scarcity area in the south presents, however, a more difficult problem. It consists of an extensive plateau comprising parts of Bombay, Hyderabad and Madras. The average annual rainfall of this area is somewhat higher than that in the scarcity areas of the north although it is equally precarious. The rainy period extends over a longer period of five months from June to October. The rainfall in September and October is higher and consists of heavy showers. On account of undulating topography and the rather impervious nature of the heavy clay soil, mostly of basaltic origin, a large part of the annual rainfall is lost by surface run-off which brings in its wake the more serious loss, by erosion, of the cultivable soil mantle, *viz.*, the loose, friable, surface soil. The dry farming problem of this tract is, therefore, twofold: the prevention of the loss of rain-water by run-off and the control of soil erosion.

Agronomic experiments are reported in the publication to demonstrate that, even in seasons when the rains prove scanty and untimely, crops can be grown successfully by simple and inexpensive modifications in the existing technique of cultivation as practised by the local agriculturists. The results of these investigations have been embodied in what is designated here as the Bombay Dry Farming Method which is a simple system of land preparation, tillage and crop cultivation designed with the aforesaid objects of conserving soil moisture and preventing surface wash. The main features involved in the Bombay Dry Farming System are (*a*) simple field bunding along the contours of the cultivated areas, (*b*) modifications in the local agricultural practices in connection with ploughing and harrowing of the land, sowing of the seed and inter-culturing the growing young crops, (*c*) the extension of manuring, especially green manuring, (*d*) the introduction of scientific methods of crop rotation and of judicious fallowing of cultivable fields, and (*e*) the cultivation of drought-resistant varieties of the major crops. It is claimed that the proposed method is simple, practicable and economically sound. It has given at least fifty per cent. more income than the preva-

---

* *Dry Farming in India*, by N. V. Kanitkar (Scientific Monograph No. 15, The Imperial Council of Agricultural Research. The Manager of Publications, Delhi), 1944, pp. 352, Price: Rs. 13-12-0 or 21 s. 6d.

lent cultivators' method when tested on their own fields over a period of seven years.

As the book is essentially a record of the research work carried out at the five experimental stations, it may be contended that it is not a monograph in the strict sense of the word. Doubtless, there are scientific aspects of dry farming which require further study although at present the greater need would appear to be for the widespread adoption, with such local modifications as may be necessary, of the principles and techniques now revealed.

A. SREENIVASAN.

SCIENCE NOTES AND NEWS

POST-WAR RECONSTRUCTION PROGRAMME FOR TRAVANCORE

Travancore has made a praiseworthy start indeed with a succinctly laid out programme outlined in the address by the Dewan Sachivothama Sir C. P. Ramaswamy Iyer to the first meeting of the Post-War Reconstruction Committee. Announcing that Rs. 7 crores will be made available over a period of three years. the Dewan said, "Transport, Canal Traffic, Coastal Shipping, Production of Power, Fertilisers and Cottage Industries—you must embark upon these, whether there is gain or not, but the other industries such as ceramics and rayon, or what may be called semi-luxury industries, on which there will be tremendous competition, will take a secondary place only". Stressing upon the fact that efficient transport is the first desideratum for post-war development, the Dewan has proposed schemes for a large outlay on Roads, including cement concreting them, the opening of a cement factory with the co-operation of the powerful Associated Cement Company, manufacture of types in the Rubber Factory in co-operation with Messrs. The Dunlop and Company, improvements of the extensive canal routes by deepening them and strengthening the banks, and for a State-controlled coastal shipping service in agreement with the Scindia Steam Navigation Company. Rs. 16 lakhs have already been allotted for the restoration of the A.V.M. and other canals between Alleppey and Trivandrum. Additional developments of the Hydroelectric power resources in the Pallivasal and Periyar areas are also necessary.

"The manufacture of fertilisers is another industry that cannot wait." The Travancore Chemicals and Fertilisers, with a capital of Rs. 5 crores, has already drawn up agreements with the Government of Madras, the Government of India and with the suppliers of machinery so that the Factory can begin work in the very near future.

One of the biggest post-war schemes should tackle the very important question of cottage industries, in order to improve the condition of the peasants. There should be a survey of the possible cottage industries, and a concentration on those which can be taken up immediately on a co-operative basis or otherwise, and with gain, under the conditions prevailing in Travancore. The Government will be prepared to subsidise and give advances in the early stages.

Programmes for forest conservation, and for efficient utilisation of timber and soft-wood for the plywood industry, and a protected plastics industry are also required. Great progress has already been made with the Aluminium Industry, the Glass Works, and the Ceramic Factory, but further developments for their continued and successful working in a keenly competitive post-war world, must be formulated. Fisheries are another great asset to Travancore, and a flourishing research backed by Fisheries Department is a great necessity.

The address is replete with concrete and practical suggestions for programming, and we wish Travancore God-speed in all these schemes, which are after all but modest and none too ambitious, and should, therefore, be realisable according to expectations. M. A. G. RAU.

The Maharaja of Travancore Lord Curzon Prize of the *University of Madras*, "for the most meritorious original investigations in the physical sciences (Chemistry)" has been awarded this year to Mr. S. Rajagopalan, M.Sc. (of the Indian Institute of Science), for his thesis on "Essays in Chemotherapeutical Synthesis".

The Joint Annual Meeting of the Indian Academy of Sciences and of the National Academy of Sciences will be held at Poona from Wednesday, the 27th December 1944, to Saturday, December 30th, 1944, at the Fergusson College. The session will be inaugurated by the Rt.-Hon. Dr. M. R. Jayakar. Sir C. V. Raman will deliver the presidential address to the Indian Academy of Sciences, which will be followed by a symposium on "The physics of the upper air" to be opened by Dr. K. R. Ramanathan. In the afternoon a symposium on "The Chemistry, Pharmacology and Therapeutics of Sulphonamides" will be led by Lt.-Col. S. S. Sokhey. The second day's proceedings include a discussion in Magnesium in Relation to Structure led by Prof. Krishnan and the presidential address to the National Academy of Sciences which will be delivered by Prof. Birbal Sahni. A symposium on "The age of the saline series of the salt range of the Punjab" will be held on the third day under the chairmanship of Prof. Sahni. The rest of the programme includes the reading of original papers, public lectures and excursions.

Dr. C. N. Acharya has received the D.Sc. of the London University for his work on the preparation of composts.

JUBILEE CONVOCATION OF THE PATNA UNIVERSITY AWARD OF HONORARY DEGREES

On the occasion of the Jubilee Celebrations, honorary Doctorates were conferred on seven-

teen eminent scholars of the country, distinguished for their contributions to the various branches of human knowledge. In the course of presenting these learned personages to the Chancellor, Sachchidananda Sinha, the Vice-Chancellor of the University, referred to the recipients as follows:—

Sir Tej Bahadur Sapru.—"One of the most distinguished of our elder statesmen and one of the most eminent publicists; also a lawyer and jurist of great reputation, honoured wherever learning and character are honoured." (LL.D.)

Sir Maurice Gwyer.—The first Chief Justice of India, "who in that capacity established a great tradition of scholarship and fairmindedness and whose remarkable gifts of organisation, tact and learning are now devoted to the cause of education as the Academic Head of the Delhi University." (LL.D.)

Khwaja Sir Mohammad Noor.—"For long a leading figure in Bihar's public life, as a firm and tactful President of the Legislature, an able, independent and upright Judge, and a successful Vice-Chancellor of the Patna University." (LL.D.)

Sir Sarvapalli Radhakrishnan, Professor at Calcutta and Oxford.—"The most brilliant exponent of Indian Philosophy, and an original thinker, who has been the academic head of the Andhra University, and is now Vice-Chancellor of the Benares Hindu University, whose reputation as a scholar and thinker, is international." (D.Litt.)

Sir Jadunath Sarkar "who was for many years professor at Patna, one of the most eminent of India's historians and unquestioned authority on the Indo-Mughal period". (D.Litt.)

Dr. Amarnath Jha, Vice-Chancellor of the Allahabad University.—"A most distinguished scholar of English language and a well-known authority on the development of English literature, who has now been for over fifteen years the Head of the English Department of the Allahabad University, and who, though a son of Bihar, has done his work so far in the United Provinces." (D.Litt.)

Sir John Sargent, Educational Advisor to the Government of India, who is responsible for the monumental scheme for educational reconstruction, which reveals his liberal and sympathetic outlook, and his firm faith in the educational future of the country. (D.Litt.)

Dr. John Matthai, one of the foremost Economists, who is now head of the great firm of The Tata,s, and is as such closely associated with plans for the economic industrial development of the country. (D.Litt.)

Mr. Debendranath Sen, "a veteran educationist, who for many years was head of one of the leading Colleges of Patna, and who is held in high regard by his colleagues and by several generations of students". (D.Litt.)

Sir Venkata Raman, who is an international figure in Physics, being one of the outstanding authorities on Optics. He gave up a promising career in Government Service, and has dedicated himself since with enthusiasm and singleminded devotion to the cause of scientific research, He has built up a remarkable school of Physical investigators, who have distinguished themselves far and wide, and to discovery of the rays known after his name has been of incalculable value. Since the death of Rabindranath Tagore he is the only Indian Nobel Laureate. (D.Sc.)

Sir Mokshagundam Visvesvaraya.—"A great and distinguished Engineer, and an eminent administrator, old in years but young in spirits. He is a unique figure in our public life, who is held in universal esteem for his high character and his constructive genius. He is an ex-Dewan of Mysore, which owes much of its prosperity to his administrative ability and engineering skill." (D.Sc.)

Dr. Sir Ziauddin Ahmad, who has long been an outstanding educationist, a Member of the Calcutta University Commission, a distinguished mathematician, the academic head of the Aligarh Muslim University, and a prominent figure in the Central Assembly, where he is regarded as an expert on railway questions and affairs. He is an authority on systems of examination in various countries. (D.Sc.)

Dr. Lakshmanaswami Mudaliar, "who has a recognised position among the leading physicians of the country. His great abilities are now devoted to the Madras University, of which he is the academic head, but he had also made great and valuable contributions to various branches of medical science". (D.Sc.)

Dr. Prof. Birbal Sahni, "who has been a Professor of Botany at Benares, Lahore and Lucknow. Himself an eminent botanist and geologist, he is also the founder of a school of research. His work in Fossil Botany has been of very great importance and the results of his researches have been widely appreciated." (D.Sc)

Dr. Homi Bhabha, "who though young in years, has already attained a position of eminence by his brilliant researches on the cosmic rays. He is not only a scientist of distinction, but is a person of versatile gifts and rare powers of exposition. Of the living Indian scientists he obtained the much-coveted distinction of F.R.S. at the early age of thirty-two". (D.Sc.)

Prof. Pran Krishna Parija, a well-known botanist, who has for several years been connected with this University, and is now the academic head of the Utkal University. He occupies a prominent position among botanists in this country. (D.Sc.)

Dr. Sir Shantiswarup Bhatnagar, "on whom the degree of Doctor of Science was conferred *in absentia*".

MAGNETIC NOTES

Magnetic conditions during November 1944 were slightly less disturbed than in the previous month. There were 19 *quiet* days and 11 days of *slight* disturbance, as against 10 quiet days, 18 days of slight disturbance and 2 days of moderate disturbance during the same month last year.

The quietest day during the month was the 13th and the day of the largest disturbance the 10th.

The individual days during the month were classified as shown below:—

Quiet days	Disturbed days
	Slight
1, 2, 7, 8, 11–17, 19, 21–25, 29, 30.	3–6, 9, 10, 18, 20, 26–28.

No magnetic storms occurred during the months of November in the years 1943 and 1944.

The mean character figure for the month of November 1944 was 0·37 as against 0·73 for November last lear. M. PANDURANGA RAO.

SEISMOLOGICAL NOTES

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory during the month of November 1944, there were five of slight and three of moderate intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.		Epicentral distance from Bombay	Co-ordinates of epicentre	Depth of focus	Remarks
		H.	M.	(Miles)		(Miles)	
6	Slight	02	26	900			
6	Moderate	12	19	1005			
11	Slight	09	51	1005			
15	Slight	05	48	1270		140	
16	Moderate	03	17	3760			Epc.: Near Philipine Islands.
16	Moderate	18	42	5765			
23	Slight	17	33	1035			
24	Slight	11	22	5505		125	Epc.: Probably near New Britain.

We acknowledge with thanks receipt of the following:—

"Journal of the Royal Society of Arts," Vol. 92, Nos. 4675 and 4677.

"Journal of Agricultural Research," Vol. 68, No. 11; Vol. 69, Nos. 2-3.

"Agricultural Gazette of New South Wales," Vol. 55, Pts: 8-10.

"Indian Journal of Agricultural Science," Vol. 13, Pt. 3; Vol. 14, Pt. 1.

"Biological Reviews," Vol. 19, No. 3.

"Biochemical Journal," Vol. 38, No. 3.

"Calcutta Review," Vol. 99, Nos. 2 and 3.

"Journal of the Indian Chemical Society," Vol. 21, No. 7.

"Journal of Chemical Physics," Vol. 12, Nos. 7 and 9.

"Discovery," Vol. 5, Nos. 9-10.

"Indian Farming," Vol. 5, No. 5.

"Transactions of the Faraday Society," Vol. 15, Nos. 9-10.

"Indian Forester," Vol. 70, Nos. 9-11.

"Genetics," Vol. 29, No. 5.

"The Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 16, No. 2.

"Horticultural Abstracts," Vol. 14, No. 3.

"Central Board of Irrigation Bulletin," Vol. 1, No. 5.

"Bulletin of the Indian Central Jute Committee," Vol. 7, Nos. 7-8.

"Mathematics Student," Vol. 12, Nos. 1-2.

"Indian Medical Gazette," Vol. 79, No. 10.

"The Review of Applied Mycology," Vol. 23, Nos. 8-9.

"Bulletin of the American Meteorological Society," Vol. 25, No. 6.

"Journal of Nutrition," Vol. 28, No. 1.

"Nature," Vol. 154, Nos. 3909-3913.

"Indian Journal of Physics," Vol. 18, No. 2.

"Journal of Research of the National Bureau of Standards," Vol. 32, No. 5; Vol. 33, No. 1.

"Science," Vol. 100, Nos. 2584, 2590, 2591-96.

"Scripta Mathematica," Vol. 9, No. 4.

"Science and Culture," Vol. 10, Nos. 5-6.

"Journal of Scientific and Industrial Research," Vol. 3, Nos. 4-5.

"Monthly Science News," Nos. 37-39.

"Sky," Vol. 3, No. 11.

"Indian Trade Journal," Vol. 155, Nos. 2002 to 2008.

BOOKS

Principles of Physical Geology. By Arthur Holmes. (Thomas Nelson & Sons Ltd., Parkside Works, Edinburgh 9), 1944. Pp. 532. Price 30/-.

Sex Education—A guide for parents, teachers and youth leaders. (Messrs. Macmillan & Co., Ltd., London, W.C. 2), 1944. Pp. 290. Price 7/6.

Radio Receivers and Transmitters. By S. W. Amos and F. W. Kellaway. (Chapman & Hall Ltd.), 1944. Pp. 281. Price 21/-.

CORRECTIONS

Vol. 13, No. 11 (November 1944)

Article entitled "Role of Domestic Animals in the Spread of Helminthic Infections in Man"—

Page 274, column 2, line 40: read *Diphyllobothrium* for *diphyllabothrium*; line 49: read *Dipylidium* for *Diphylidium*.

Page 275, column 2, line 16: *read* recorded *for* reecorded.

Page 276, column 1, line 25: *read* sources of infection *for* source of infections.

Article entitled "Production of Light-Effect Under X-Rays"—

Page 278, Heading of the note: *read* Light-Effect *for* Eigat-Effect.

1513-44 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D. for The Current Science Association Bangalore